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The Institute of Vitreous Enamellers
The Welsh Engineers' and Founders' Association
and
The Foundry Trades' Equipment and Supplies Association

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The Factory Report

As was generally anticipated, there was an increase in the total number of accidents recorded in 1937, the aggregate being 192,539, of which 1,003 were fatal. This was due to the general increase in employment, and the introduction into factory life of large numbers of unskilled or partly trained persons was the major contributory factor. Next year a drop should be registered, due to decreasing industrial activity and the enforcement of the new Factories Act. It was interesting to note that the foundry industry is given as an example of the continued tendency to mechanise, and a description is given of the manufacture of gas stoves using a continuous casting plant. The onlooker "sees most of the game," and the plant is aptly described as being "arranged on three levels, the top being the distribution level, the centre the working level, and the bottom the sand return level." Candidly, we never looked at such plants from this angle, which is quite a good one. Both Mr. D. R. Wilson, H.M. Chief Inspector of Factories, and Mr. H. H. C. Thomas, superintending inspector, make reference to the rather alarming increase in the number of accidents in connection with the use of asbestos cement sheets for roofing. "Roofs covered in this way," writes Mr. Thomas, "look safe, especially when blackened by the weather, and for this reason are, in fact, death traps." Since 1930, there have been no less than 403 accidents, of which 68 were fatal. Whilst it is pleasing to note the reduction in accidents—68 as against 91 in 1936—due to wood-working machinery, they are still too common, and the sensible notion is advanced that for the more dangerous machines, the foreman should approve the setting up of the machines before use on a new type of job—a practice followed by some firms.

Extended reference is made to the serious explosions which occurred in a North of England foundry through molten steel finding its way through a fissure in a mould and encountering dampness. It will be remembered that three lives were lost, and, what is still worse, it was not an isolated case within the industry, and "there were several other similar explosions."

Mr. Wilson is still far from satisfied with the number of accidents to young persons, and when the Chief Inspector so expresses himself, it behoves industry to "sit up and take notice," otherwise, he is quite liable to make recommendations to the Home Secretary for action to be taken, which will lessen the risks, but may increase production costs. A careful perusal of the chapter in the Report specifically devoted to this subject shows that accidents can be materially reduced by assuming—and rightly so, too—that lads have a natural tendency to skylark. Intelligent anticipation of this trait by the management, this anticipation extending to the meal hour breaks, will do much towards reducing accidents to the minimum.

The incidence of lead-poisoning in the vitreous enamelling trade was limited to three cases. Two were due to the enamelling of glass bottles by spraying, and are therefore divorced from connection with the foundry industry. It is pleasing to note that the situation in respect to sand blasting is improving, and the tendency noted in the 1936 Report to revert to sand for blasting purposes has been arrested and reversed. This Report for 1936 gave the total accidents in the foundry section of the metal industry as 11,123, of which 38 were fatal; for 1937, these figures were 12,819 and 40. Fatal accidents due to falling bodies have been reduced from 15 to 8—a figure still too high—and those due to lifting machinery from eight to six. These accidents due to falling bodies, the nature of which it is somewhat difficult to visualise, have increased from something of the order of 1,300 to over 1,500. We again ask, "Surely this figure could be reduced?" It means that one foundry out of every three has to report an accident due to this cause, and as some of them are quite small, employing but two or three moulders, the question is really serious. We are aware that many directors are worried about hours of employment in certain branches of the industry, and a perusal of Chapter V of the Report is worth while, as it discloses some information about the practical operation of the Act. Welfare is still a major preoccupation of the Factory Department, and it is stressed that Welfare "pays." In general, and especially for the larger concerns, we are in full agreement. For the smaller concerns, the close contact between the "boss" and the few workpeople employed induces conditions of sympathetic understanding, rendering "welfare" as applied to the larger factories almost unnecessary. The Home Office Industrial Museum has now been visited by some 90,000 people since it was opened in 1927, and the Report cites a number of cases where a distinct profit has accrued to firms resulting from a visit by an executive. A fact not generally appreciated is that the museum acts as an information bureau on all the ramifications of the Factories Act.

Correspondence

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Control in Chilled Shot Manufacture

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—The remarks of Mr. J. H. Cooper in his contribution to the discussion of the Paper "Sand Blasting as Applied to the Vitreous Enamelling Process," and which appeared on page 21 of your issue dated August 4, have attracted the writer's attention. The suggestion put forward by him that shot may be grey and graphitic and, consequently, deposit graphite on the castings undergoing cleaning, in addition to rapidly disintegrating, is completely unsound. The risk of chilled shot containing graphite as produced by accredited and experienced manufacturers is absolutely negligible, and the facts are that chemical analyses made of specimens of shot and grit collected from a wide variety of sources, all show that graphite is completely absent. This suggestion of Mr. Cooper's is so misleading that it is felt necessary to make this comment.

Mr. Cooper's additional statement that German manufacturers exercise more care in the selection of their raw materials (than presumably British manufacturers) cannot be taken seriously either. The "hitting on the anvil" test referred to by him as being used in Germany as a criterion of the quality of the final product is not one to inspire much confidence in their methods of control. The writer would refer Mr. Cooper to the Paper by Mr. J. E. Hurst and Mr. Bradshaw given before the Sheffield Branch of the Institute of British Foundrymen last year. This Paper gives full details of the system of metallurgical control adopted by one firm, and this included routine control of the analysis, hardness, toughness and strength, specific gravity, microstructure and particle size and shape. The writer refers to this as an example of the amount of care taken in the manufacture of shot and grit, and it is his desire that shot users should appreciate the fact that the whole resources of modern metallurgical science are applied in shot manufacture with a view to maintaining the highest possible degree of quality.—Yours, etc.,

"BRITISH GRIT."

August 9, 1938.

"Riddle of the Sands"

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—I was interested in your remarks under the above heading in THE FOUNDRY TRADE JOURNAL dated August 4, 1938. The question of expansion and contraction is without doubt the greatest problem the foundryman has to contend with. All intelligent foundrymen know this, and have done since they commenced to become intelligent in the manufacture of castings.

All foundrymen in responsible positions will surely not dispute the fact that expansion does take place during the drying of a mould or core made in any sand, because where heat is applied to anything, such is a natural fact.

In view of this, therefore, what is to be gained by trying to prove an already known fact? The only method to overcome such defects as occur due to expansion, and the contraction which surely follows, is to use sand with a low expansion in parts of the mould which are likely to give trouble. The latter method has been in use for many years by all foundrymen with ordinary intelligence; in fact, it is known to be impossible to obtain many classes of important castings unless such methods are employed. The trouble at the moment is to obtain a refractory material which will allow us to heat up a mould to a temperature which is close to that of the metal. When the day arrives and we have such a material, contraction troubles in our castings will never be seen again. In the writer's view, a great deal of the sand "Riddles" given of late is of little use to the man who is producing the goods.—Yours, etc.,

W. MACHIN,
Foundries Superintendent.
Vickers-Armstrongs, Limited,
Barrow-in-Furness.
August 10, 1938.

[This letter has been slightly abridged.—EDITOR.]

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—In the issue of the JOURNAL dated August 4, appeared a leading article under the heading "Riddle of the Sands." This leader calls attention to the danger of basing fundamental facts upon individual experience, and mentions particularly opinions that may be expressed in connection with mould surface defects. The writers were recently concerned in the presentation of a Paper on moulding sands, in the course of which details of experiments made for determining the cause of scabs were described. These experiments were not undertaken to prove a theory, nor were they confined to any particular sand; and although probably unorthodox to the purely scientific mind, they served to show that many other factors outside the expansion and contraction phenomena have a vital bearing on the formation of these defects. Any observation of a practical character, even if taken on a particular sand, which would provide a basis for investigation should commend itself to foundrymen as a body, and while not attempting to belittle the work of experts on such matters, every encouragement should be given to men who are concerned with the production of castings to formulate their own conclusions from practice, and make them public to the industry. Only by team work in its very fullest sense can the cream of opinion be obtained, and that will be the time to co-ordinate the results and pronounce an opinion.

Your very active interest in the sand problem augurs well for the satisfactory solution of the difficulties that attend the production of castings in sand moulds, and we hope that you will continue to assist investigations through the medium of your valuable paper.—Yours, etc.,

S. CARTER (Kaye & Company).
A. W. WALKER (Thos. Broadbent & Sons, Limited).
Huddersfield.
August 15, 1938.

Book Review

Modern Furnace Technology. By H. Etherington, B.Sc., A.R.S.M. Published by Charles Griffin & Company, Limited, 42, Drury Lane, London, W.C.2. Price 30s. net.

A strikingly interesting book which will be of value not only to the furnace builder and works engineer, but to anybody using furnaces of any type. The author is obviously fully conversant with his subject and his book is a happy blend of clearly explained scientific data and a wealth of practical information and formulæ. The principles of gas flow and heat transfer are dealt with in a comprehensive manner and the methods of calculation and some rather novel and ingenious ones are illustrated by several examples. The section dealing with the practical solution of heat transfer problems will be found exceptionally useful.

The reviewer, who is himself a furnace designer, believes this book to be a really worth while addition to the bookshelves of those having either the design or conduct of furnaces under their control.

P. F.

Random Shots

August is frequently called the "silly season," by which one is supposed to understand that there's "not much doing." "If silly means slack, then you're right," said Bill the foreman, for he had just been listening to a lot of "scientific slop," as he called it, from an Ardent Young Scientist from the research department. The foundry manager was away on holiday, and departments are apt to mingle more at such time. "But, you know, 'e sort of set me thinkin' a bit. Arsked me why we talked of 'wrought iron,' for instance. We work iron and it is wrought; we do good deeds and they are wrought. Yet you, Bill, sez 'e, can say you are overworked, but not that you are overwrought. (Bit of peace when the manager's away!)."

The idea seemed to grow on Bill, for he remarked that "the Old Josser called Shakespeare was a playwright, but his plays weren't wrought—they were wrote. And my old man was a wheelwright by trade, but I'm blowed if his wheels were wrought; for all that they went round all right!"

So the A.Y.S. said he'd write to "Marksman" about it, who thereupon set out to settle the question. Taking down a very dusty Murray, he found all manner of exciting information about the word "wrought." It is, in brief, a word with a history, and can be used in many senses. Of wrought iron itself, the great book says "it is a slag-bearing malleable iron," and that a thing "wrought" is made or constructed by means of labour or art. But it can also mean "stirred up, excited, stimulated or enlivened." Thus Crabbe used it so "to watch the wrought-up heart and to conquer by surprise." Incidentally, in some last century literature a "wroughter" is used as meaning a "man who plays the three cards." (Could it possibly be the three card trick?)

All the wrights, strangely enough, seem to have been workers in wood. Thus, there were the shipwrights, timberwrights, wagonwrights, wainwrights, wheelwrights, cartwrights, etc. Playwright seems to be the exception which proves the rule, but have not plays even been known to be wooden?

In short, in the good old days when our forefathers spoke Anglo-Saxon, the verb to work was written "wycan" or "wircan," which had a past tense and a past participle called "worhte" or "geworhte," whence comes the present wrought. Wright, on the other hand, can claim to be a direct descendant of "wyrhta" or "wyrht," a noun meaning, of course, a work.

And now, having become overwrought with so much work, what more natural than to resort to a little liquid refreshment? Bill, the foreman, and the A.Y.S. to their long draught of cool ale (by the way, is there any connection between the draught and the coolness, or should it be a draft?) And "Marksman" to his town bred taste, the cocktail. Here there should be a word of warning to all who would take a cocktail. Avoid those frosty faced bottles as you would a frosty faced barmaid, for they have caught the eye of one of H.M. Inspectors of Factories, who does not approve of sandblasting merely for effect. Even he is moved to ask, in the new Factory Report, if a cocktail tastes any different for coming out of a bottle with a frosted exterior? Sandblasting is dangerous and not to be used lightly, is his argument; and he is quite right. So is cocktailing, but he wisely leaves the interior effects to another department. His job is to criticise the exterior whilst enjoying the interior. So here's how!—and Happy Shooting!

MARKSMAN.

Artistic Castings at the Empire Exhibition

To make a limited but representative selection of light metal articles from the point of view of design is no easy task, because both mass-produced work and the work of individual craftsmen have to be taken into consideration. There can be no question but that the mass-produced goods are the more important, as influencing the taste of a vastly greater number of people—generally speaking, the craftsman's work is high in price, even if it were available in competitive quantity—but the craftsman has an influence out of proportion to the number of his customers because he appeals to people who take an active interest in the progress of design. On their stand in the Palace of Industries (North) at the Empire Exhibition, the Scottish Committee of the Council for Art and Industry has found it possible to include both classes of work.

THE ARTISTIC CASTINGS EXHIBIT AT THE EMPIRE EXHIBITION ARRANGED BY THE SCOTTISH COMMITTEE OF THE COUNCIL FOR ART AND INDUSTRY.

Most of the light metal exhibits are grouped in one large case, attractively designed, like the rest of the stand, by Mr. J. Duncan Miller. The largest pieces are stoves by Smith & Wellstood, Limited, Glasgow, and Allied Ironfounders, Limited, and an electric cooker by British National Electrics, Limited, Motherwell. They hardly require comment: modern stoves and cookers are on the whole, æsthetically speaking, as far in advance of the articles of twenty years ago as the streamlined locomotive, from the engineering point of view, is in advance of Stevenson's "Rocket." The age of apology, when the designer of metal goods felt obliged to disguise the nature of his work, is long past. Cookers in particular merit high praise—they express their function and emphasise their qualities of cleanliness and simplicity of operation with an economy of effort which is sometimes quite masterly. The big dog-grate made by the Carron Company is, by contrast, traditional in design, but is very handsome in its way. Shanks, Limited, contribute a simple but effective towel rail—bathroom fittings is another field in which the designers have made amazingly rapid progress in recent years. An electric radiator in which the heating elements in their chromium plate setting contrasting with a matt white ground form the entire decorative scheme is another successful piece: it, too, comes from British National Electrics. Then there is a good specimen of a gutter by Walter Macfarlane & Company, Glasgow, and a rainwater head by the Carron Company. There is a certain tendency to revert to the fine old forms of those adjuncts of the house of past centuries, but the simplicity and even severity of them suggests that the designers know what they are about.

The craftsman's work includes an attractive iron fire-screen by Mr. Thomas Bogie, Edinburgh, a simple framework enclosing a rhythmical openwork design carried out in strips of metal. This must be classified under the same head as a companion set and a coal box by Mr. Charles Lindsay, Glasgow. A group of pleasing silver articles of the "craft" group come from Mr. M. J. Thomas, of the Glasgow School of Art. This stand includes, in addition to light metal goods, articles from the textile trades, furniture, books and examples of printing. Its object is less to emphasise the quality of Scottish work than to indicate a standard of design, or of æsthetic quality, for the inspection of the manufacturers and of the public. It should hardly be necessary at this stage to argue the importance of such exhibitions. Design can no longer be looked on as an unimportant feature of any article; it must be considered the outward expression of the article's qualities, and the more ably and appealingly it expresses those qualities the better it is. Good design is of even greater importance in industry than a good manner, address and smartness of appearance are in business, for, other things being equal—as they so frequently are in these days of close competition—the buyer's choice between two articles will almost invariably depend on their appearance.

The Council for Art and Industry and its Scottish Committee were appointed by the Board of Trade in 1934. At first they concerned themselves mainly with an inquiry into the possibility of raising the level of taste among the buying public; their recommendations were published by H.M. Stationery Office as separate reports. At a very early stage, however, sub-committees were appointed to examine conditions in the various important industries in any way concerned with design, among them the light metal industry. In each case at least one or two members of the industry were co-opted to the sub-committee.

D

The Scope and Possibilities of the Latest Synthetic Materials for Plastic Moulding

By A METALLURGICAL CORRESPONDENT

Plastic moulding is the term applied to the production of articles in synthetic resins of which there are a variety of different types. The properties of these have been dealt with very concisely in a Paper by Dring before the Institution of Production Engineers. Plastic moulding materials as a class constitute a material which can be used for the manufacture of articles which alternatively could be made in metal. They must be regarded therefore as complementary to metals and alloys and for this reason their properties are of considerable interest to the foundry industry. The following details of the properties of plastic moulding materials are extracted from the above-mentioned Paper. Regarding the properties of the various plastic materials, the industry is relatively so young and is growing so rapidly that it is quite impossible to give the kind of data which are available in stabilised form with regard to metals. Though efforts are being made in the plastic industry to compile such data, no single book or publication gives all the information required.

One attempt at a fairly comprehensive classification of the properties of plastic materials was given in chart form in a fairly recent issue of the American journal "Modern Plastics." It must be realised, however, that differences in test procedure and sizes of test specimens may lead to erroneous conclusions in some cases if direct comparisons are attempted. Special grades of material are often available which excel in one particular property.

Tensile strengths vary widely from 900 to 13,000 lbs. per sq. in., whilst specific gravities range from 1.05 for the styrene resin plastics, up to 1.70 to 2.09 for phenol-formaldehyde compounds with a mineral filler. In the case of the methyl methacrylate resin or organic glass, the tensile strength ranges from 7,000 to 9,000 lbs. per sq. in., the specific gravity is 1.18 and the flexural strength in lbs. per sq. in. is from 15,000 to 17,000. The softening point of this material is from 170 to 235 deg. Fah.

Bulk Factor

From the point of view of moulding technique, the compression ratio, or what is generally known in this country as the "bulk factor," is an important property. This varies from 2.0 to 3.0 in the case of unfilled woodflour-filled materials. This factor is the ratio of the volume of moulding powder to the volume of the finished article.

Mineral-filled phenol formaldehyde materials have ratios up to 7.1, with, for example, a filler of fibrous asbestos material. In the case of fabric fillers, the bulk factor is as high as 11. Such fillers can vary from ground cotton up to the well-known flaked fabric materials. Mechanical properties are a combined function of the resin or binder and the filler, and quite a wide variation is possible by altering the proportions of the constituents.

Table I shows a more general list of properties of different types of plastics, and is abridged from a chart compiled by the American journal "Modern Plastics."

TABLE I.—*Typical Properties of Various Groups of Plastic Materials.*

Properties.	Phenol-formaldehyde moulding compounds.			Urea-formaldehyde compound. Alpha cellulose filler.	Vinylchloride acetate resins unfilled.	Methyl methacrylate resin.	Styrene resin.	Shellac compound.	Casein.	Cellulose acetate.	Cellulose nitrate.
	Woodflour filler.	Mineral filler.	Fabric filler.								
Compression ratio (bulk factor)	2.5–3.0	2.2–7.1	2.5–11.0	3.0	2.0	2.0	2.5	—	—	2–2.8	—
Specific gravity	1.34–1.52	1.70–2.09	1.37–1.40	1.48–1.50	1.34–1.36	1.18	1.05–1.07	1.1–2.7	1.35	1.27–1.63	1.35–1.60
Tensile strength in lbs. per sq. in.	6,000–11,000	5,000–10,000	6,500–8,000	8,000–13,000	8,000.10,000	7,000–9,000	5,500–7,500	900–2,000	7,600	3,500–10,000	5,000–10,000
Modulus of elasticity, lbs. per sq. in. × 10^6	10–15	10–45	7–12	16	3.5–4.1	6	4.6–5.1	—	5.1–5.7	2–4	2.4
Compressive strength, lbs. per sq. in.	16,000–30,000	18,000–36,000	20,000–32,000	24,000–35,000	—	8,000	13,000–13,500	—	—	11,000–16,000	—
Flexural strength in lbs. per sq. in.	8,000–15,000	8,000–20,000	10,000–13,000	13,000–15,000	10,000–13,000	15,000–17,000	6,500–8,000	—	—	5,200–8,300	—
Impact strength, ft.-lbs. C–Charpy, I–Izod, N–Notched, U–Unnotched.	0.10–0.28 I, N	0.11–0.36 I, N	0.4–2.4 I, N	0.7–1.5 C, U	0.3–0.6 I, N	0.25–0.5 C, N	0.16–0.25 I, N	—	1.0 I	3–12 C, N (per sq. in.)	3–12 C, N (per sq. in.)
Softening point (deg. C.)	None	None	None	None	130–160	170–235	110–200	150	200	145–260	160–195
Breakdown voltage, 60 cycles, volts per mil (instantaneous)	300–500	250–400	300–450	650–720	400–500	480	500–700	100–400	400–700	800–850	600–1,200
Power factor 10^3 cycles	0.04–0.15	0.10–0.15	0.08–0.20	—	0.0143	—	0.0001	—	—	—	—
Water absorption, immersion 24 hours	0.2–0.6	0.01–0.3	1.0–1.3	1–2	0.05–0.15	0.3	0.00	—	3.7	1.4–2.8	1.0–3.0

TABLE II.—*A Strength/Weight Comparison of Plastic Material and Cast Iron.*

	Phenolic resinoid. Col. I.	Cast iron. Col. II.	Phenolic resinoid. Col. I div. by S.G.	Cast iron. Col. II div. by S.G.
Specific gravity	1.35	7.5	1.0	1.0
Tensile strength (tons per sq. in.)	3–5	14–18	2.2–3.7	1.86–2.4
Bending strength (tons per sq. in.)	4–6	18–27	3.0–4.5	2.4–3.6
Compression strength (tons per sq. in.)	10–18	35–50	7.4–13.4	4.7–6.7
Young's Modulus (tons per sq. in.)	300–700	3,000–9,000	220–520	400–1,200
Impact strength (ft.-lbs.)	0.14–0.22	0.7–1.4	0.1–0.16	0.09–0.19

An interesting comparison of the mechanical characteristics of phenolic moulding materials with cast iron was made by Caress, and is summarised in Table II. In this table, column 3 shows the figures for phenolic moulding materials divided by the specific gravity 1.35, whilst column 4 gives corresponding figures for cast-iron divided by the specific gravity 7.5. The result is a kind of comparison of strength per unit volume or specific strength, and it may be seen that in many cases the figures for the plastic materials are superior, weight for weight, to those for cast iron. Engineers will know that the table does not cover the whole story, but the data are of considerable importance when considering the use of plastic materials for engineering purposes.

Regarding engineering applications, the motor industry is becoming plastic conscious, whilst the use of all kinds of plastics in the manufacture of aircraft is being considered for almost every part of the structure, including body, wings, fuselage, propellers, windows, and accessory equipment. In this connection a valuable Paper by Dr. de Bruyne was published by the Royal Aeronautical Society in July, 1937.

Regarding the total production of plastics, statistics compiled by the Board of Trade show an increase in Great Britain from a total of 12,680 tons for the year 1933 to 23,245 tons during 1936. In his Presidential Address to the Institute of the Plastics Industry, Sir Gilbert Morgan also stated that during 1935 the world production of phenolic resins alone reached 60,000 tons, of which U.S.A. were responsible for 28,000 tons, Germany 15,000 tons, England 9,000 tons, Russia 1,000 tons, Italy 1,500 tons and Sweden 674 tons.

Future Developments

In the opinion of the author, the plastics industry has hardly commenced, and all the real achievements lie in the future. Those plastics that have already been established will no doubt maintain their industrial importance, but the coming of any new plastic with a different combination of properties usually opens up a new application in another industrial field. Both the number of products and the number of uses will inevitably expand. In the future it may be possible to take certain raw materials, react them in a certain way, and so make a resin with predetermined physical characteristics, but that day has not yet arrived.

Pig-iron and Steel Production on N.E. Coast

Dorman, Long & Company, Limited, announce the blowing out of another blast furnace, this one being at their Redcar works. This step has been occasioned by the need for relining the furnace, which, it is believed, has established a record in this country. The furnace has produced a total of nearly 800,000 tons of basic pig-iron at an output of 2,300 tons a week. Relining is to begin immediately, and the opportunity is being taken of equipping the furnace with mechanical charging gear. It is anticipated that the furnace will be again brought into commission as soon as this work is completed. A new open-hearth has just been completed at the North Steel Works belonging to the same company. It has a capacity of 100 tons and operates solely on coke-oven gas. This method of firing has been successfully employed on three other furnaces in the same shop.

The Effect of Foundry Variables

MECHANICAL PROPERTIES OF SAND-CAST TENSILE TEST SPECIMENS ARE MODIFIED*

By H. J. ROWE (Metallurgical Engineer, Aluminium Company of America)

The popularity of the tensile test as a means for production control is well deserved. The validity of the data obtained from this test is, however, dependent upon strict control and uniformity of conditions surrounding the making of the tension test specimens themselves.

It is the purpose of this discussion to attempt to clarify and summarise the effects of various foundry variables on the mechanical properties of tension specimens cast in aluminium alloys. The variables discussed are those encountered in moulding practice, gating design, melting and pouring technique, and in the handling of test specimens during trimming and heat-treating. The effect of machining the gauge sections of test specimens is also considered.

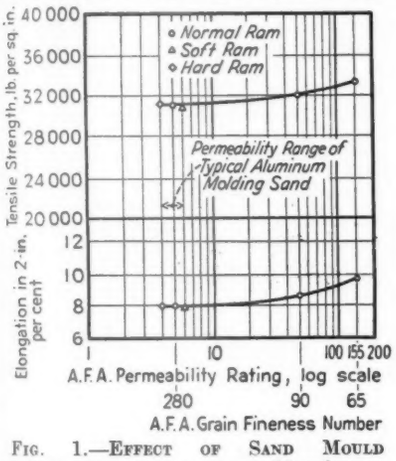


FIG. 1.—EFFECT OF SAND MOULD PERMEABILITY ON THE MECHANICAL PROPERTIES OF ALLOY G, HEAT-TREATMENT NO. 1.

It is realised that the data presented are far from complete in so far as the numerical effect of each variable on the properties of all the aluminium alloys is concerned. Sufficient data have been obtained, however, to indicate the general effects of these variables and the control necessary for maximum uniformity.

Moulding Practice

Sand Permeability.—One of the most important factors in moulding considerations is sand permeability. Upon this factor depends the rapidity with which gases, including steam, which may form an insulating film between the metal and green sand mould, are dispersed. If these gases, which, of course, develop from the moisture in the sand, escape rapidly through the mould, the metal achieves more intimate contact with the sand, and hence is chilled more rapidly than when a gas film is maintained for a longer period.

The permeability of a moulding sand depends to a great extent upon the size and shape of its individual grains. The coarser grained sands generally have higher permeability values than do fine grained sands, particularly when the grain shape is such as to provide a maximum space between the particles. The sands used for aluminium alloy founding must, however, be fine enough to resist the high sand searching power of the metal. To accomplish this, permeability is sometimes sacrificed to obtain smooth surfaces.

The effect of sand permeability on the mechanical properties of cast test specimens of alloy G is illustrated in Fig. 1. A wide range of permeability, considerably above that of normal aluminium sands, is included. It will be noted that both tensile strength and elongation increase as the permeability increases.

It is to be expected that mould permeability might decrease somewhat as the sand grains become more and more closely packed by ramming. This is true to a certain extent, since the lower permeability of moulds in which the sand grains are too closely packed by ramming, often results in what are generally termed "hard ram blows."

Included in Fig. 1 are also data relative to the change in permeability of a sand used extensively for casting aluminium alloys as affected by hard or light ramming. Since this change in permeability was not great, the mechanical properties of test specimens were not noticeably affected.

TABLE I.—*Sand-Cast Aluminium Alloys Included in Tests.*

A.S.T.M. alloy.	Nominal chemical composition, per cent.						Typical mechanical properties.	
	Copper.	Iron.	Silicon.	Zinc.	Magnesium.	Nickel.	Tensile strength, lb. per sq. in.	Elongation in 2 in., per cent.
Grade C	7.0	1.2	2.0	2.0	—	—	23,000	1.5
Grade G*	4.5	—	—	—	—	—	31,000	8.5
Grade H	4.0	—	—	—	1.5	2.0	37,000	0.5
Grade JJ ..	—	—	5.0	—	—	—	19,000	6.0
Grade L	—	—	—	—	3.8	—	25,000	9.0
Grade N† ..	1.3	—	5.0	—	0.5	—	35,000	3.5

* Heat treatment No. 1. † Heat treatment No. 2.

The alloys for which the data presented in the following discussion were obtained are covered by A.S.T.M. Tentative Specifications B 26-37 T† (see Table I for nominal chemical and mechanical properties). Much of the experimental work was carried out on alloy G, since this alloy reflects well the variations in foundry conditions.

As an illustration of the influence of the more drastic chilling provided by iron moulds, the nominal tensile strengths of several alloys when cast in sand and permanent moulds have been compared graphically in Fig. 2. These graphs show the average tensile strengths of test specimens of alloys JJ, C and N (heat-treatment No. 2), when cast in permanent moulds to be 26, 17 and 23 per cent. higher respectively than those of the same alloys cast in normal aluminium foundry sand.

Sand Strength

Sand strength is also important. If the strength of a moulding sand is low, the test-bar moulds are readily distorted, either while being made or in later handling. Such mould distortion may result in specimens which are imperfect with respect to roundness and straightness. These imperfections may introduce appreciable errors during measuring, testing and computation of results. Low sand strength may also cause sand dropping or washing, which is, of course, undesirable, since such sand usually becomes embedded in the test specimen and results in some reduction in mechanical properties.

The strength of moulding sands generally used for casting aluminium alloys is obtained from a natural clay bond and added moisture. These constituents are generally maintained at percentages sufficient to provide a moulding sand strength of about 5 lbs. per sq. in. This strength is developed in a sand with a grain fineness of 260 to 300 and a clay content of about 20 to 30 per cent. by weight, with 6 to 7 per cent. by weight of moisture.

Pattern Equipment.—In addition to the use of suitably controlled moulding sands, it is, of course, also very important to provide good pattern and moulding equipment. Loose flasks as well as warped or worn equipment often cause shifting or sagging of the moulds and other dimensional irregularities.

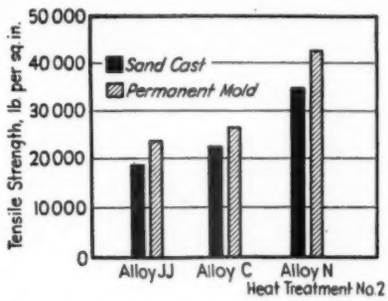


FIG. 2.—EFFECT OF EXTREME CHILLING ON TENSILE STRENGTH.

Gating Design

The design of a gating for the casting of aluminium alloy test specimens should incorporate such features as to provide a maximum of soundness in the specimens as well as uniformity in conditions surrounding the solidification of the metal in the mould. This is done by the use of well-placed sprues and risers, together with proper distribution of the metal by means of correctly designed runners and gates.

The number of test specimens to be accommodated on one gate must also be considered carefully, since this factor has a marked influence on the economics of the production of test specimens. Since it is preferable from the standpoint of cost to provide more than one test specimen on a gate, the design of the gating should also be such as to provide maximum uniformity among specimens on a single gate.

In order to illustrate the effect of various features of gating designs on the magnitude and uniformity of the mechanical properties obtained, five designs, two of which are widely used, have been selected for discussion. These are illustrated in Fig. 3.

Of the gating designs shown, the 3-bar and 6-bar types are what may be classed as single end gatings, the metal entering the specimen cavity from one end. One disadvantage of this type of gating is the excessive heating of the specimen cavities by the hot metal which runs through them, causing a tendency toward slower solidification and lowered mechanical properties. This is particularly true of the 6-bar mould, because of the greater volume of metal involved.

The particular 3-bar type of gating shown has the added disadvantage of providing metal at varying temperatures to the various specimen

* Extended abstract of a Paper read before the American Society for Testing Materials.

† Tentative Specifications for Aluminium-Base Alloy Sand Castings (B 26–37 T), *Proceedings*, Am. Soc. Testing Mats., Vol. 37, Part I, p. 678 (1937); also 1937 Book of A.S.T.M. Tentative Standards, p. 300.

cavities, reducing the uniformity of the mechanical properties obtained.

The 2-bar and 4-bar types of gatings shown in Fig. 3 may be classed as double end gatings, the metal entering the specimen cavities from both ends. The advantage of this type of gating lies in the more favourable solidification conditions provided by the lower mould temperature. This is obtained by symmetrical gating, which eliminates the flowing of metal completely through the specimen cavity.

The symmetrically gated 2-bar mould has been widely used for a number of years with excellent results. The 4-bar design is an adaptation of a similar design frequently used for other materials. It incorporates the desirable features of the 2-bar design, and the results obtained are

Two Bar. Modified Two Bar. Three Bar. Four Bar. Six Bar.

FIG. 3.—DESIGNS OF GATINGS FOR THE CASTING OF ALUMINIUM ALLOY TEST SPECIMENS.

comparable with those obtained from that design.

The modified 2-bar design incorporates a slanting sprue, which is offset somewhat from the centre of the runner. This was developed to permit the streams of metal from the ends of the specimen cavities to meet in the grip sections, rather than in the gauge sections, so as to eliminate oxide films which have been encountered occasionally in the gauge section of specimens cast from the magnesium-bearing aluminium alloys. The modified 2-bar gating has been used only on alloys of this type.

The uniformity and magnitude of the tensile strengths obtained from specimens cast in various types of moulds are shown in Fig. 4. Cast aluminium alloys G, H and JJ were used in the various comparisons. All specimens were cast under identical conditions except for the gating used. No tests were discarded because of oxide or gas inclusions.

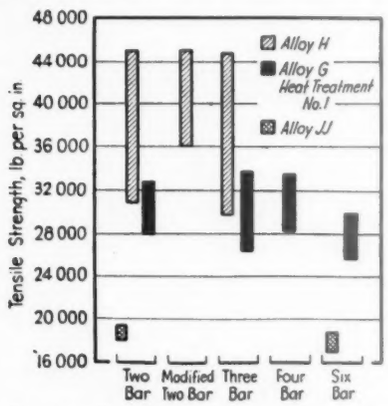


FIG. 4.—EFFECT OF MOULD DESIGN ON UNIFORMITY OF TENSILE STRENGTH.

It will be noted that in the tests in which alloy G was used, the spread between maximum and minimum tensile strengths obtained with the 2-bar and 4-bar gatings was less than that of the 3-bar, and slightly more than that of the 6-bar design. The average tensile strengths obtained using the 2-bar and 4-bar gatings were, however, slightly higher than that obtained with the 3-bar design and considerably higher than that obtained with the 6-bar gating.

In the tests involving alloy JJ, the tensile strengths obtained from specimens cast in the 2-bar mould showed slightly less variation than did those cast in the 6-bar moulds. The average tensile strength obtained using the 2-bar design was again higher than that of specimens cast in 6-bar moulds.

The data representing alloy H show the magnitude and uniformity of the tensile strengths obtained when this alloy was cast in the 2-bar, the modified 2-bar, and the 3-bar moulds. These tests illustrate the material improvement in uniformity of the tensile strengths obtained by the change from the vertical to the slanting sprue when using the magnesium-bearing aluminium alloys.

Fig. 5 summarises the average differences in tensile strength between the highest and lowest values obtained from individual moulds of test specimens of alloys G and H cast in 2-bar and 3-bar moulds. These graphs show the specimens cast in the 2-bar type of mould to have a materially lower average difference in tensile strength between specimens in the same mould, than specimens cast in the 3-bar mould.

Melting Conditions

The melting conditions used for aluminium alloys exert a profound influence on the structure and therefore on the mechanical properties of the cast material. Thus, test specimens reflect faulty melting practice in their mechanical properties. In melting aluminium alloys the temperatures are preferably maintained as low as possible not only to minimise oxidation losses and to provide as fine a grain-structure as possible in the finished casting, but also to minimise gas absorption. Holding temperatures and times are also kept at a minimum for the same reasons. In the melting and holding process, the absorption of gases, principally hydrogen, at melting and alloying temperatures has been the subject of considerable study. In general, the amount of gas absorbed depends on the alloy, the metal temperature, the time of exposure, and the concentration of gases at the exposed metal surfaces. The most common manifestation of gas absorption is probably that known as pinhole porosity.

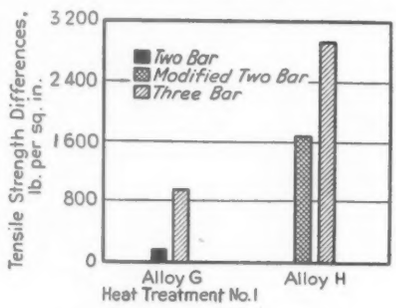


FIG. 5.—AVERAGE VARIATION IN TENSILE STRENGTH BETWEEN INDIVIDUAL BARS FROM THE SAME MOULD.

The effect of melting temperature on the mechanical properties of aluminium alloy sand-cast test specimens is illustrated in Fig. 6. The specimens were cast at a temperature of 1,250 deg. Fah. (675 deg. C.), the metal having been heated in melting to temperatures ranging from 1,300 to 1,600 deg. Fah (700 to 870 deg. C.).

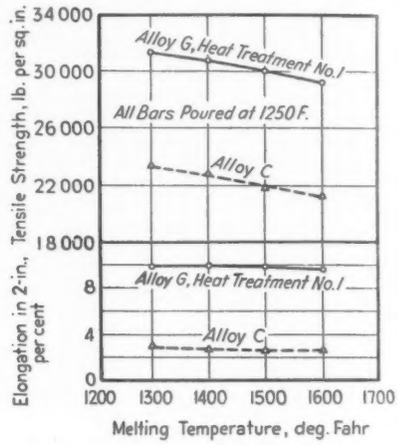


FIG. 6.—EFFECT OF MELTING TEMPERATURE ON THE MECHANICAL PROPERTIES.

It will be noted that the tensile strengths show a decided drop as the melting temperature is increased, although the elongations were not so noticeably affected.

Pouring Practice

The use of careful skimming, the correct pouring temperature, a low pouring height, and the proper pouring speed, are all essential to the production of test specimens of uniform quality.

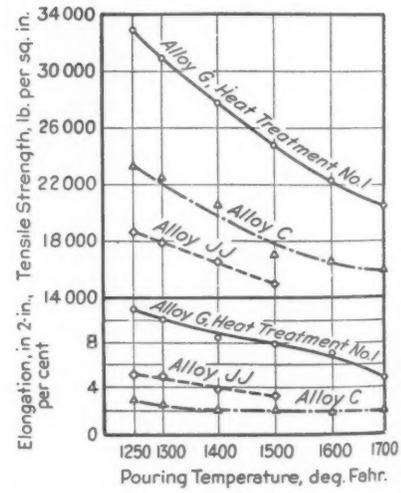


FIG. 7.—EFFECT OF POURING TEMPERATURE ON THE MECHANICAL PROPERTIES.

Since dross or oxide inclusions in the gauge section adversely affect the mechanical properties of cast test specimens by reducing the effective cross-section of the specimen, or producing high localised stress concentrations, it is, of course, important that the cleanest possible metal be provided at the mould. To this end it is advantageous to skim the metal at the mould just before pouring.

The pouring temperatures used for aluminium alloy test specimens, as for any casting, should be those which provide the most favourable solidification conditions for the optimum

mechanical properties. The pouring temperature which provides these solidification conditions will vary with the section thickness and design of the part being cast. Once the test specimen gating is established, the proper pouring temperature can be readily determined. In the case of the majority of pattern designs for the standard ½-in. diameter aluminium alloy specimens, a pouring temperature of 1,250 to 1,280 deg. Fah. (675 to 690 deg. C.) has been found to meet these requirements most adequately, depending on the alloy involved.

Fig. 7 illustrates the reduction in mechanical properties obtained by pouring test specimens of alloys C, G and JJ, at temperatures ranging from 1,250 to 1,700 deg. Fah. (670 to 925 deg. C.) in the 2-bar type of mould. The grain size increases markedly with the higher casting temperature.

Pouring height and pouring speed, while not generally stressed, are also important factors in the making of aluminium alloy castings. Too great a pouring height may result in the inclusion of trapped air or oxide in the test specimens. The pouring speed should, in general, be that which will fill the mould as quickly as possible without undue metal agitation. The pouring speed is usually limited by the size of the sprue, which sprue should be kept filled

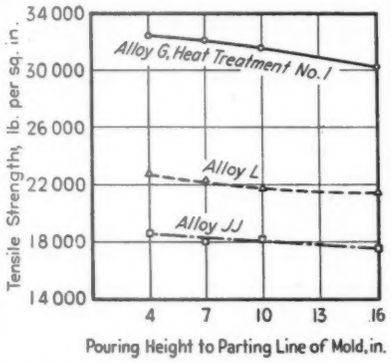


FIG. 8.—EFFECT OF POURING HEIGHT ON TENSILE STRENGTH.

in order to prevent excessive metal agitation and to allow oxide and trapped air to float out instead of being forced into the casting.

The effect of pouring height on the tensile strengths of test specimens of alloys G, JJ and L is illustrated in Fig. 8. The curves show the tensile strengths of all of these alloys to be definitely reduced as the pouring height is increased. This reduction probably results from increased amounts of porosity which occur in the specimens as the pouring height is increased.

Shape and Surface Condition of Specimens

Variations in surface and shape of tensile specimens, such as shifts caused by weak sand or loose moulding equipment, surface roughness caused by rough mould surfaces, and out-of-roundness resulting from drastic rapping of the pattern, may influence materially the observed mechanical properties of tension specimens. This influence may be manifested as errors in measuring specimen diameters, variations in breaking loads resulting from non-axial loading of the specimen, or stress concentrations from surface imperfections. With proper moulding technique and equipment, together with the use of appropriate methods for measuring specimen diameters, the effects of these variables can be minimised.

During the shaking out, identifying, trimming, and heat-treating, care must be exercised to prevent marring the surface, bending or otherwise damaging the specimens. Such damage may result from shaking out the moulds while too hot, striking the specimens too hard when stencilling identification numbers on them, nicking the gauge sections in trimming, and improper packing during heat-treatment.

In view of the foregoing considerations, some foundries prefer the option of casting aluminium alloy tensile test specimens to somewhat larger diameters than the standard 0.505 in. in order to permit the machining of the gauge sections to final dimensions. The effect of such machining on the mechanical properties of test specimens of alloy G has been investigated. In this investigation, test specimens cast to 0.565-in. diameter using the 2-bar gating were machined to a diameter of 0.505 in. and the mechanical properties compared with those of standard cast-to-size specimens from the same melts of metal and using the same gating.

These tests, which included approximately 150 specimens of each type, showed the mechanical properties of the cast-to-size and machined specimens to be practically identical in magnitude and uniformity.

Cumulative Effect of Foundry Variables

Many of the variables discussed may not, in themselves, result in a sufficient reduction in the strength of aluminium alloy test specimens, to be considered serious. However, the cumulative effect of several of these insignificant conditions may become appreciable. In fact, the difficulty experienced in diagnosing the cause of low properties in many cast test specimens is often due to the fact that they are the result of several factors rather than a single one.

It is, of course, not correct to assume that the effects of all the individual factors mentioned are numerically additive. It is quite possible, however, to reduce the tensile strength of aluminium alloy test specimens as much as 40 per cent. by the cumulative effect of the conditions considered. The necessity of strict control in all phases of the production of such specimens is therefore essential if the subsequent tension tests are to be of maximum value.

Early Bronze Casting in China

BY E. A. SMITH, A.R.S.M.

China, the land of early metallurgical enterprise, has long been famous for bronze castings of exceptional artistic merit, and the interesting question of their production has again been brought into prominence by Mr. R. S. Jenyns, who has recently drawn attention to a number of early Chinese bronzes from the Eumorfopoulos Collection, now in the British Museum. They are figured and described, with comments on their probable date, in the British Museum Quarterly, Vol. XI, No. 3. The oldest bronze described is the famous ram-handled *tsun*, which is a remarkable example of the bronze-founder's art, and belongs either to the Shang-Yin (1766-1122 B.C.) or early Chou Dynasty (1127-947 B.C.).

As stated by Prof. W. E. Soothill (Professor of Chinese in the University of Oxford), "we know something of the culture of the Shang Dynasty, and there is evidence that it had risen to an interesting degree of artistic development, especially in the making of bronze vessels and the carving of jade. The first important book on antiquities, written in the tenth century A.D., contains illustrations of existing bronze vessels of the Shang Dynasty."

There is evidence, however, of bronze casting before the Shang-Yin dynasty, as it is recorded that, at the beginning of the Hsia dynasty (2205-1766 B.C.), the Emperor Yu cast the famous nine bronze cauldrons, often mentioned in historical records, from metal sent up from the nine provinces, which were preserved as palladia of the empire until about the third century B.C.

The ram-handled *tsun* from the Eumorfopoulos Collection is modelled in the form of two rams standing back to back, and is supported on four legs represented by their forefeet. From between their heads, which act as handles, rises the funnel which forms the mouth. The body of the vessel is covered with scales, which may or may not have been engraved after the casting, and the funnel with a mask on each side in bold relief. These masks are a characteristic of the Shang-Yin culture, but they are not confined to that period. The *tsun* shows only one of the four innovations regarded by Karlgren as making their appearance at that period. It must, therefore, be very closely related to the Shang-Yin bronzes. Mr. Jenyns expresses the opinion that "this piece should convince sceptics that the Chinese bronzes of the classic period are equal, if not superior, to those of any civilisation." The height of the *tsun* is 17 in., and the diameter across the handles 16 in., whilst the diameter across the mouth is approximately 7 in.

Highly Developed Technique

As Jenyns remarks, "it is difficult to account for the sudden appearance of the Shang-Yin culture, which produced highly complicated and distinctive bronzes without apparent effort. These bronzes display a complete mastery of technique and reveal conventionalised motives which argue a long process of evolution. The inscriptions which they carry are far from primitive, yet there is still an enormous hiatus in time to be accounted for between the remains of Neolithic pottery excavated in Western Kansu and the Yellow River Basin in Honan and these highly sophisticated vessels.

"Up to the present no excavation of sites that preceded the Shang-Yin culture has revealed fragments in either bronze or pottery which bears any real relation to these very finished works of art. We are at a loss to find their immediate ancestors. The Hsia culture during which the early bronze forms were established and during which the art of bronze-casting must have made its first appearance remains a mystery. Even if we support the theory that the art of bronze-casting was introduced in its finished form from the West at a period immediately preceding the Shang-Yin, the existence in the Shang-Yin bronzes of forms and motives which are obviously of great antiquity and which betray no affinity whatsoever to any known Western forms, is difficult to explain away without admitting a long process of internal evolution. We are compelled to believe that the Shang-Yin culture had its roots in a very distant past, but why almost no traces of that past have survived is a puzzle for which archæology has yet to supply a happy solution."

The history of bronze casting in China in prehistoric times has yet to be written, but in dealing with the early sources of supply, the late Prof. W. Gowland pointed out that, in Yunnan, tin-stone occurs in abundance in the old river gravels not far from deposits of copper ores and native copper which have been worked from the earliest times. Tin appears to have been known and used by the Chinese as a constituent of bronze from a very remote antiquity, probably as early as 3000 B.C.

Unfortunately, archæological exploration in China has been of a very limited character, hence practically nothing is known from actual finds of the Early Bronze Age culture of that ancient people.

Fourth International Rail Congress

The fourth International Rail Congress, 1938, is to be held in Düsseldorf in the period September 19 to 22 next under the patronage of the Reich Minister of Transport, DR.-ING. J. DORPMÜLLER; it is being organised by the German Reichsbahn and the Verein deutscher Eisenhüttenleute. These congresses have been held trienially since 1927, and aim primarily at an improvement in rail materials. Problems to be discussed at the coming Congress include the wear of rails, and their testing and welding. Details regarding the Congress may be obtained from the Verein, Ludwig-Knickmann Strasse 27, Düsseldorf.

Budgetary Control and Standard Costs

II.—REPETITION FOUNDRIES AND THE BUDGET

By T. McALPINE

A foundry engaged in repetition work will be in a favourable position to operate a complete system of budgetary control. Two of the essentials for preparing budgets are:—(*a*) Complete records of previous performances and costs; and (*b*) a knowledge of market trends and general trade conditions. There are several budgets which must be prepared, if full control be desired, but if any foundry is unwilling to incur the expense of operating a complete system, then it can have the benefits of a modified system by preparing only those budgets which it considers essential for the necessary control.

Dependent upon the degree of control required, all, or any, of the following budgets may be prepared:—

(1) The Sales Budget gives an estimate in quantities and values of the probable sales for the period. The quantities give a guide in the preparation of production programmes, while values indicate the probable income of the business for the period.

(2) The Production Budget shows the probable production in terms of saleable products and component parts, and is suitably analysed to provide the data required for the preparation of a production programme for each department. Amalgamated with the Production Budget may be the Cost Budget, which shows the cost of production departmentally by products and by component parts.

(3) The Plant and Equipment Budget, which shows:—(*a*) The expenditure to be made on installing new plant, extending buildings, etc., and in making tools, patterns, moulding boxes, coreboxes, etc.; and (*b*) anticipated expenditure in respect of repairs and maintenance of plant and equipment, buildings, tools, patterns, etc.

(4) Payroll (or labour) Budget, which is usually sub-divided to show:—(*a*) The estimated labour cost of carrying out the production shown on the Production Budget. This is usually sub-divided to show the labour cost to be incurred by each department. If possible the number of employees likely to be required in each department should be shown; and (*b*) the estimated number of salaried employees in each department and the salaries to be paid.

(5) The Oncost Expense Budget confines itself to forecasting the indirect expense of each department.

(6) The Indirect Labour Budget is really a subdivision of the Oncost Expense Budget, but the information it shows is also necessary for the Payroll Budget.

(7) The Material Budget shows the various kinds of materials to be used and the estimated consumption of each. It is usually prepared in two sections; one for direct materials and the other for indirect materials. The latter section is a subdivision of the Oncost Expense Budget.

(8) The Purchase Budget shows the quantities to be bought of each material and the time when these purchases should be made.

(9) The Auxiliary Department Budget shows the probable expenditure in running such departments as the accounts department, sales department, counting house, secretarial department, etc.

(10) The Financial Budget is a forecast of the probable income and expenditure of the business and the result of the year's working. It also shows in detail the anticipated position at the end of the period with regard to assets and liabilities.

The Sales Budget

This is the first Budget to be made out and can usually be prepared by the sales manager after consultation with salesmen and travellers. Each salesman can give an estimate of sales demand for each product in the territory which he covers and the sales manager can then decide whether the estimate is a reasonable one.

At least two records should be maintained in connection with a sales budget:—(*a*) A record showing the anticipated sales of each product for the year, and for each month of the year with columns provided to register actual sales for comparison purposes; and (*b*) a record for each salesman showing (with any other information required) the anticipated sales of each product in the territory which he covers (as shown by his budget) with columns provided for recording actual sales for comparison purposes. A sales budget provides the sales manager with valuable information for controlling the sales of each product and for reviewing the performance of each salesman, and it advises the management of the probable income of the business and the quantity of goods to be made during the ensuing year to satisfy sales requirements.

SALES BUDGET FOR YEAR ENDING 19 .

12 months to December, 19 .	Sales budget.		Actual sales.	
	Qty.	£ s. d.	Qty.	£ s. d.
Products—				
X				
Y				
Z				

Most foundries are requested by customers to supply replacement parts and these should be treated as a separate product in the budget. It is usually impossible to budget in detail for replacement parts, and an estimate based on the sales of these parts during the previous year will probably prove the most satisfactory solution.

Where a large number of component parts are produced it is not always a simple matter to maintain balanced production. Proper control will only be possible if accurate stock records are kept and when parts are drawn from stores for replacement orders additional care is necessary to ensure that the production programme is adjusted to maintain balanced stocks.

Form 2 is an example of a sales budget in its application to a foundry making a small range of products.

The Production Budget

The object of the Production Budget is to obtain maximum output with the minimum of expense, and this can best be assured by knowing in advance what to make and how much to spend in making it.

The Sales Budget gives a guide as to what to make, and to plan a production programme the following formula should be applied in respect of each product.

Estimated sales for the year ... =
+ Quantity to be held in stores at the close of the year ..... =
− Quantity in stores at the commencement of the year ..... =
= Quantity to be produced during the year.

To decide cost of production, each product must be sub-divided into its component parts, and the cost of each part recorded departmentally. A summary of component parts cost will give a cost by products, and a summary of the latter costs will give total cost of production.

In many instances it will be possible to incorporate the Cost Budget in the Production Budget, and this is the course adopted here. The Production and Cost Budgets which follow are designed to provide the following information:—

(*a*) The tonnage of metal of each mixture which will be required during the year for moulding shops.

(*b*) The total number of castings off each pattern which will be required during the year in respect of each product.

(*c*) The probable number of workers to be employed in direct labour in each department during the year.

(*d*) The cost of production by parts and by products for each department.

(*e*) The probable consumption of direct material in each department. If possible, this information should be detailed to show the consumption of each kind of material to enable a Purchase Budget to be prepared.

Incidentally, the Production Budget provides useful information for preparing a Plant and Equipment Budget, in so far as it indicates whether the plant and equipment is sufficient to carry out the production programme or whether additions will be necessary.

On completion of the Production Budget, the first point to be checked is whether the Sales Budget has been properly planned to make full use of all production facilities. For instance, a Sales Budget, no matter how excellent it may appear to a sales manager, cannot be regarded as satisfactory if it fails to provide sufficient work for some machines, and yet provides too much work for others. If these conditions exist, then the Sales Budget will have to be reconsidered with the object of bringing it into line with production capacity.

Later forms will be reproduced to indicate a method of preparing a Production and Cost Budget for a loose-pattern moulding shop, a continuous casting plant, and a coreshop respectively. Each form will cover one class of product only, and will be, in effect, a list of the parts included in the finished product.

To simplify the procedure let it be assumed that a certain foundry manufactures three different types of products, X, Y and Z, and that three departments can allocate productive time to each pattern, namely, loose-pattern moulding

MONTHLY COMPARISON OF ACTUAL SALES AND BUDGET SALES.

Month.	Product X.				Product Y.				Product Z.				Total.	
	Budget.		Actual.		Budget.		Actual.		Budget.		Actual.		Budget.	Actual.
	Qty.	£ s. d.	Qty.	£ s. d.	Qty.	£ s. d.	Qty.	£ s. d.	Qty.	£ s. d.	Qty.	£ s. d.	£ s. d.	£ s. d.

Form 2.—Sales Budget.

shop, continuous casting plant, and coreshop, while the remaining departments, fettling shop and grinding shop, cannot allocate productive time against pattern numbers.

If 500 of **X** have to be made the first step is to prepare a list of the castings and the number off each pattern required to make one **X** and by multiplying these numbers throughout by 500 it can be ascertained just how many castings off each pattern are required to make 500 **X**. This list will be made out for each department and all castings required for the finished product will be included, even though some of the castings shown will not be worked upon by all departments. For example, the list made out for the coreshop may include castings which do not require cores, and the list for the loose-pattern moulding section will show castings which are made by the continuous casting plant and *vice versa*. This ensures uniformity and also enables time to be saved since some form of duplicating machine can be used. The same procedure will be followed for **Y** and **Z**.

In the case of those departments which cannot allocate their time direct against pattern numbers, some satisfactory method of charging their labour and oncost to each casting must be devised. With the fettling and grinding shops several methods are possible for allocating labour and oncost in the absence of a direct charge. For instance, the charge to be made to each casting may be based on:—

(*a*) A fixed rate per ton or hundredweight, or
(*b*) A percentage of moulding cost, or
(*c*) A percentage of moulding and core-making cost combined.

The class of castings produced will determine the method to be used, but (*c*) will generally be found the most satisfactory in practice.

In Part I of this article, printed last week, a rather obvious misprint occurred, where in the last line the "cost of the saleable goods" was printed as £10,000 instead of £100,000.

(*To be continued.*)

Book Review

"A Manual of Foundry Practice" By J. Laing and R. T. Rolfe, F.I.C. Second Edition. Revised and Enlarged. Published by Chapman & Hall, Limited, 11, Henrietta Street, London, W.C.2. Price 18s. net.

The authors are to be congratulated on the compiling of the second edition of the book, especially in respect to the alterations and very valuable additions which have been made.

Plate and machine moulding is dealt with in Chapter 5, and it is suprising that the authors have not given more illustrations and more space to moulding machines, especially power machines. In view of the trend of the industry the student of foundry practice, who is desirous of obtaining all the help and information he can respecting the latest types of moulding machines, will no doubt regret this.

Chapter 7, which deals with loam moulding, is good in so far as it goes, but it would have been more valuable if illustrations were shown of simpler jobs which would be of greater value to both the student and those of the foundry, but not in it. Those shown will be appreciated by the skilled moulder, but are not very helpful to the uninitiated. Unfortunately, in the reviewer's copy, fifteen pages are missing from this chapter, which may contain some of the items complained of. If that be so, then the chapter will be an asset.

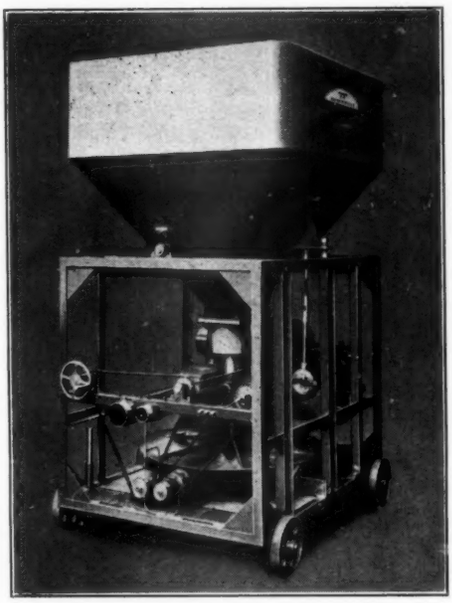
Non-ferrous founding is covered by Chapter XI, and the additional eleven pages from the first edition adds value and will be found of great help and usefulness.

Whilst there are sections which can be improved, it has to be recognised that there are difficulties to be overcome in attempting to deal with this subject in one volume. The authors have given a very useful work which every student and apprentice should peruse.

Portable Pulverised-Fuel Firing Unit

In the early days of pulverised fuel, its use was limited to the comparatively large consumer because the application called for the installation of a complete pulverising plant, the throughput of such plants of even the smallest practical size being much in excess of the small consumer.

With the establishment of central works for the production of pulverised fuel, the difficulties of the small consumer have been eliminated. Pulverised fuel of a guaranteed calorific value delivered in either tanks or bags is now obtainable in many districts and thus is extending the field of usefulness of pulverised-fuel firing. Where several small firing units are grouped, however, a pulverising plant is often more economical. Undoubtedly it is the most economic form



Portable Pulverised-Fuel Firing Unit.

of heat raising, while it possesses a flexibility, one might say, equal to oil and not much less than that of gas.

If we are to get the maximum available value from the use of pulverised fuel, combustion efficiencies approximating to 80 per cent. must be obtained and maintained, a figure which can only be reached by suitably-designed firing equipments. To serve its most useful purpose the equipment must be provided with a ready and simple means of adjusting fuel supply over a very wide range.

The T.T. equipment, which we illustrate, manufactured by T. Toward & Company (1932), Limited, of Newcastle-upon-Tyne, would seem very well to fill the requirements. It has been particularly designed to meet the demand for small unit installations and, as will be seen, is very compact, occupying a floor space of 4 ft. by 3 ft., and is entirely self-contained, and being mounted on wheels it is strictly portable, so that in the small works it might be utilised for various heating duties.

A feature of the equipment is its instant adjustability to give a wide range of output, say, from 30 to 120 lbs. per hr. At any pre-determined output the equipment can be thermostatically controlled. The equipment may be supplied with a two-speed motor drive so that an approach to a pre-determined temperature results in a drop to half-throughput of fuel and a complete stoppage occurs only when the selected temperature is actually reached. Time switches may be employed so that, at any selected time the heat output can be halved or doubled automatically and will still be under thermostatic control.

The above approaches very near the ideal conditions for metallurgical furnaces, process furnaces, core-drying, and kilns, by giving definite control over air supply, complete control of temperature and also of the duration of heating.

There are no mechanical complications embodied in the equipment, which consists essentially of a receiving hopper for the pulverised fuel and a lower chamber which houses a fan, its driving motor and the fuel-air mixing chamber in which is also incorporated the blast pipe to the burner. It may here be noted that the flame cannot blow back in the burner, for as will be understood from the following description, the requisite air for combustion is not added until the ignited fuel arrives in the furnace.

The feed hopper, which is mounted on top of the apparatus, is maintained under a slight vacuum so that during filling operations, which would normally be from bags, there is no escape of dust to atmosphere. The feed holes into the hopper are provided with wire-mesh pockets in order to intercept any foreign matter. In the bottom of these pockets there are slitting knives which automatically cut the bags as they are dumped into the hopper. At the maximum rate of feed the hopper capacity is a 9-hrs.' supply, but, obviously, it is governed by the rate of feed and may be anything up to a 24-hrs.' supply.

The hopper is pivotally mounted on trunnions and is given a slight rocking movement by an eccentric shaft, which receives motion through a reduction gear driven from the main motor. The swing of the hopper is controlled by stops in both directions, the impact imparting, as it were, a jigging action.

The tendency to de-aeration for which the action might be responsible is negatived by a flexible rubber sleeve, which is interposed between the hopper outlet and the blast pipe, the pulsations set up in this sleeve being such as entirely to eliminate all possibility of decompacting of the fuel and at the same time to ensure a definite weight of fuel being delivered for each revolution of the feed screw. In point of fact, tests have shown that the apparent density of the fuel fed to the screw is actually less than the density as fed into the hopper from the bags. Obviously, this means that a less volume of air will be required to deliver the fuel, and the air and fuel are more intimately mixed.

The feed screw is a helix of tapering diameter, so formed that the pitch of the threads can be varied to meet the required range of feeds. The output between the chosen rates of feed can be infinitely varied whilst the apparatus is in operation, which is accomplished by a variable-speed friction drive through a hand wheel.

The necessary air is delivered by a directly motor-driven fan past the lower end of the feed screw and through the blast pipe. A valve is inserted at the entry to the blast pipe by means of which and a hand-control gear the volume of air passing can be regulated to very narrow limits.

From the foregoing it will be seen that the installation of the apparatus calls for nothing more than a passage for the burner into the furnace chamber. As the carrying wheels are mounted upon permanent jacks, the adjustment of height is a very simple matter, where close coupling is desired.

Large-scale extensions to the Banbury Works of the Northern Aluminium Company, Limited, Birmingham, are announced, to double the works' present manufacturing capacity of aluminium and special aluminium alloys in semi-finished form.

Corrosion Resistance

AVAILABLE PROTECTION PROCESSES REVIEWED

The Fifth Report of the Corrosion Committee, published recently by the Iron and Steel Institute (Special Report No. 21), contains the first Report of the Protective Coatings Sub-Committee. This Committee in the course of their work sent out various *questionnaires* to different undertakings. These *questionnaires* and a summary of the replies are published in the Report, and we append some extracts relating to galvanising and painting, followed by extracts from a contribution to the Report by H. SUTTON and C. BRAITHWAITE on "Protection of Steel by Coatings other than Paint."

Lives of Coatings

An interesting point brought out with regard to the life of galvanised coatings is that sea air seems to have no markedly adverse effect on these coatings; whereas painted fencing seems to fail more rapidly at the sea coast than inland, no similar difference in the behaviour of galvanised coatings has been observed.

The good service obtained from galvanised coatings in rural districts is illustrated by the fact that the galvanising on towers situated in a mountainous region with frequent mists in North Wales is reported to be in good condition after 15 years.

Further information concerning the lives of coatings is given in several replies. In one case, the galvanising on two towers erected near the sea began to fail after 10 years; in another, for which the actual conditions of service are not specified, galvanised towers erected in 1929 began to show signs of rapid deterioration in 1935.

Finally, some cases of excessively rapid failure of galvanised members, exposed to industrial conditions, are reported by one company. For example, the galvanised coating on a large tower supporting a main transmission line, erected in 1924 near a brass foundry, was found to have disappeared almost entirely towards the head of the tower two years after erection, although it was in fair condition on the main body lower down. The tower was wire-brushed and painted with three coats of proprietary paint; as a result, it was unnecessary to repaint it for a period of nine years. In the case of a second tower erected later within a few yards of the older one, only the head was galvanised. The galvanised coating was found to be in fairly good condition after five years' exposure, but the whole of the tower was repainted then, because of the unsatisfactory state of the original paint on the lower portions. The most striking example, however, of the effect of industrial fumes relates to a line erected in 1912 across coke ovens and alongside a shale tip at a colliery. In 1914 the galvanising had almost entirely disappeared from the channels and catenary wires, which were so badly corroded that paint would not adhere. The wires had to be renewed in 1917 and the channels (3½ by 2 by ¼ in.) in 1927.

Comments. — The rates of corrosion of small zinc plates freely exposed in a vertical position, as determined in the experiments of the Corrosion Committee and in earlier work of the British Non-Ferrous Metals Research Association, are given in Table I. They have been expressed in ounces per square foot, and the life of a 2-ozs. per sq. ft. coating has been deduced by simple proportion.

It is, of course, obvious that the results will vary considerably according to the conditions of exposure even within a given locality, and also that calculations based on the results of one year's exposure must necessarily be very approximate. Moreover, the design of the structure will also affect the results, *e.g.*, horizontal channels in which water collects might be expected to corrode more rapidly than vertical members. However, since the field tests of the American Society for Testing Materials have shown that the life of heavy zinc coatings depends essentially on their thickness,* the values deduced for the "probable lives" may at least be accepted as rough approximations. In the case of Sheffield, for example, in which a life of six years is deduced, it may be noted that Sir Robert Hadfield and S. A. Main observed that the zinc coating on the outside of galvanised sheets on the roofs of Hadfield's Sheffield works had weathered off after five years' exposure. Since these sheets carried rather less zinc—actually from 0.85 to 1.35 ozs. per sq. ft.—this observation agrees well with the figure given in Table I and with the practical experience of the Central Electricity Board. It will also be seen from Table I that there was no marked difference in the rates of corrosion of zinc at Southport and Bournville, or at Calshot and Llanwrtyd Wells, respectively. This agrees with the failure of the Central Electricity Board to observe any marked effect of sea air on galvanised coatings.

TABLE I.—*Rate of Corrosion of Zinc in Various British Atmospheres.*

Locality.	Type of atmosphere.	Rate of corrosion of zinc. Ozs. per sq. ft. per year.	Probable life of a 2 ozs. per sq. ft. coating. Years.
Cardington	Rural, dry	0.068	29
Bournville	Suburban	0.113	18
Wakefield	Semi-urban	0.155	13
Southport	Marine	0.124	16
Birmingham	Urban	0.233	9
Woolwich	Semi-industrial	0.088	23
Sheffield	Industrial	0.392	5
Llanwrtyd Wells	Rural, wet	0.080	25
Calshot	Marine	0.080	25
Motherwell	Industrial	0.110	18
Farnborough*	Rural	0.053	38
Sheffield University	Urban	0.192	10

* 5-year test; all other tests 1 year.

Paints and Procedure

There is some divergence in painting procedure from one undertaking to another. Some of them give details of comparative tests on different paints. As a result, one group of companies has drawn up standard specifications for the painting of various types of equipment; for example, in the case of poles carrying high-tension lines, a proprietary red-lead primer is specified, followed by two coats of a proprietary micaceous-iron-ore paint. The same painting procedures are adopted by two other companies.

As a result of experience with several types of paint since 1911, one of the associated companies considers that this method of painting gives the best results; for their lines, which are near the coast, repainting is necessary every three to four years. In their experience, tar and pitch mixtures and bituminous paints are inclined to crack after some years. Another company states that a priming coat of lead-oxide paint over properly scaled and cleaned steelwork, followed by two coats of good paint after erection, should give adequate protection for five years, but adds that in practice it is difficult to ensure that the first coat of priming paint is properly applied at the maker's works; moreover, the conditions at the site (in South Wales) render it difficult to apply the two final coats of paint during suitable weather conditions. The company considers that the conditions in the field do not lend themselves to good painting and doubts whether further painting is of any real use once corrosion has obtained a hold.

The Central Electricity Board pay normal attention to surface treatment prior to the application of a red-lead priming coat, the steel being washed, wire-brushed and cleaned. Two finishing coats, consisting either of one coat of graphite and one of lead paint or of two coats of ferric-oxide paint, are applied in the field. Paint coats of this type normally show deterioration on copper-bearing steel after five years under all conditions of exposure, and repainting is then necessary in industrial districts.

Red-Lead Primer

Another company specifies the application of a priming coat of red-lead paint at the works after wire-brushing, followed by an intermediate coat of sublimed blue-lead paint at the site and a final coat of green chromium-oxide paint. The average life of this three-coat painting is about four years. Repainting is necessary at intervals of three to five years and chromium-oxide paint is used. They find this method superior to their original one, which consisted in the application of red-oxide paint followed by coloured bituminous finishing coats. The red-oxide paint had the disadvantage of drying slowly, and the coloured bituminous paints proved unsatisfactory. In this connection, it may be noted that, as a result of painting tests made in 1927, another company came to the conclusion that a proprietary grey oil paint was superior to a number of proprietary bituminous paints.

On the other hand, two companies write well of bituminous paints. One states that in the case of a line in North Wales, passing over a mountainous district, with frequent mists, on which it is necessary to repaint the towers every two years, bituminous paint has been found to give the best results. These towers were originally coated with a red-oxide primer followed by aluminium bituminous paint. Black bituminous paint was used by the second company on two early steel-mast lines erected in 1922, which run through a perfectly clean atmosphere in the agricultural districts of Herefordshire. The only protective coating applied to these masts over a period of 12 years was one coat of black bituminous paint. During the last two years they have been cleaned and given a good coating of green bituminous paint; they are in surprisingly good condition to-day.

Comments

As regards the composition of the paints, the specifications may be regarded as amongst the best for practical purposes, since they comply with the main desiderata, clearly illustrated by the results of the work of the main Committee, that the priming coat should be of an inhibitive character and the outer coats of a good moisture-excluding paint. It may, however, be noted that the "lives" of the paint coatings, as given in the replies to the *questionnaire*, are in good agreement with the Committee's observations. In a very polluted atmosphere at Sheffield and on the Welsh mountains at Llanwrtyd Wells, the best three-coat paint combinations applied to the exposure stands have lasted for rather more than four years.

It is probable, however, that the life of the initial painting could be materially increased by paying more attention to the surface treatment of the steelwork before painting. As an indication of what can be achieved by proper surface treatment, it may be noted that in some exposure tests conducted in a suburb of Birmingham, the average life of seven different two-coat paint films has already exceeded 5.6 years when applied to pickled wrought-iron surfaces, as compared with 2.1 years on similar specimens that had merely been hand-cleaned after an initial weathering period.

In view of the unfavourable experience of some undertakings with bituminous paints, it may be of interest to add that the performance of such

* This statement may not hold true below a certain minimum thickness.

paints is appreciably improved by the addition of aluminium pigment. For example, the use of tar paints containing 12 to 15 per cent. of aluminium is very popular in France. The aluminium floats to the surface of the paint film, which, when dry, has practically the same appearance as an aluminium paint proper. The "crocodiling" of the bituminous paint is materially reduced by the presence of the aluminium. It is important, however, to select the right kinds of tar for the paint, and it should be added that the Corrosion Committee have not, as yet, made any independent comparisons of the behaviour of paints of this type on iron and steel with that of oil paints.

PROTECTION OF STEEL BY COATINGS OTHER THAN PAINT

Electro-Deposits of Zinc

Experience has shown the high importance of the thorough cleaning of the work before plating. The samples for this series of tests were prepared for plating by anodic cleaning in 35 per cent. (by volume) sulphuric acid at a current density of 100 amps. per sq. ft. For pieces of irregular shape it is of importance to use baths of good throwing-power, and in this respect the cyanide baths are probably the best. In the tests described here the samples were plated at a current density of 4 amps. per sq. ft. with deposits of an average thickness of 0.0005 in., which is equivalent to a weight of 2.66 ozs. per sq. yd.

Experience has shown that good-quality electro-deposits of zinc (0.0003-0.0005 in. thick) on steel are capable of affording a substantial degree of protection against corrosion, *e.g.*, 12 months under the intermittent sea-water spray test result in only the first signs of rusting. After 18 months' exposure about 25-50 per cent. of the surface is usually coated with rust, but in the case of similar pieces to which varnish or enamel has been applied subsequently to zinc-plating, no rusting has occurred in 18 months' exposure to the test.

From observations received from Singapore during the exposure tests, it was noted that moderate to heavy barnacle deposits became attached to all the samples after 40-80 days' exposure, with the exception of the zinc-plated steels with or without subsequently applied organic protectives. It would appear that the zinc coating had better anti-fouling properties than the aluminium-sprayed coatings.

The electro-deposited zinc coatings on both steels afforded relatively poor protection against corrosion under tropical marine conditions at Singapore, the samples being very badly rusted at the conclusion of the tests.

The loss of tensile and elongation properties of mild steel, zinc-plated and subsequently painted, was very small indeed, but, in the case of the mild-steel samples zinc-plated only, there was a somewhat greater loss of tensile strength and elongation value.

In the case of the high-tensile steel strip, samples zinc-plated and painted suffered loss of both tensile strength and ductility, while samples zinc-plated only showed substantial loss of strength and ductility. It should be noted in this connection, however, that the high-tensile steel was very thin material (0.011 in.).

The application of the organic coatings over the electro-deposited zinc coatings gave fairly satisfactory results, but the protection afforded was not so great as that of sprayed-aluminium coatings without any subsequent organic coating.

Cadmium Plating

The following details relate to the treatment of samples used in the tests:—(1) Anodically cleaned in sulphuric acid before being plated. (2) Plated at 10 amps. per sq. ft. in cadmium-cyanide bath (cadmium cyanide 1.5 to 3 ozs. per gall.; sodium cyanide, 5 to 10 ozs. per gall.) to give 0.0005-in. deposit (= 3.2 ozs. per sq. yd.).

Samples of cadmium-plated mild-steel sheet, some of which were subsequently coated with two coats of grey pigmented-oil varnish to specification D.T.D.62 and others with a neutral mineral oil, were subjected to the intermittent sea-water spray test at Farnborough over a period of one year. Samples of the steel anodically cleaned and others with the scale left on were coated with the above organic protectives and exposed to corrosion test with the cadmium-plated samples.

The samples of steel strip, cadmium-plated and subsequently coated with varnish, were in excellent condition at the conclusion of the exposure test, and the samples of untreated strip coated with varnish were in good condition, but there were some rust spots along the edges of the latter samples.

Nickel Plating

Nickel electro-deposits thinner than 0.0015 in. are normally porous, and it is usually found that such deposits are not capable of affording high-efficiency protection to steel against corrosion under severe conditions such as marine atmospheres.

Sound nickel deposits can, however, be produced in thicknesses over 0.0015 in. by the use of suitable conditions and methods. Good results have been obtained with deposits produced under the following conditions:—(1) Steel samples anodically cleaned in sulphuric acid. (2) Plated with nickel in a bath containing nickel sulphate 240 grms., sodium chloride 15 grms., and boric acid 30 grms. per litre; *p*H 5.6-6, temperature 35 deg. C., and current density 10-15 amps. per sq. ft. (3) Minimum thickness of deposits 0.0015 in.

Samples with heavy nickel deposits of this kind have been exposed to the intermittent sea-water spray test at Farnborough for six months without showing any sign of rust.

Chromium Plating

Chromium plating direct on steel is seldom used for high-duty protection against corrosion. Chromium electro-deposits are usually applied as a thin finishing coating over electro-deposited coatings of other metals on steel. The main reasons for which chromium is not applied directly to steel are:—(1) The high cost of chromium plating to give thick deposits, and (2) the difficulty of depositing sound, adherent chromium deposits of reasonable thickness directly upon steel.

Chromium coatings under 0.0005 in. thick are normally porous, and do not offer appreciable protection to steel against corrosion under severe conditions. Samples of steel with a thin coating of electro-deposited chromium, subjected to the intermittent sea-water spray test at Farnborough, carried a large amount of rust after four months' exposure. Samples of steel with chromium deposits over 0.0005 in. thick showed only traces of rust after one year's exposure to the above test, and after 20 months' exposure there was still some of the coating intact. This result suggests that sound, heavy chromium deposits applied directly to steel may prove of value, and probably superior to chromium on nickel for the protection of steel against corrosion under severe conditions.

Electro-plated-chromium coatings on steel are usually applied over a preliminary deposit of other metals such as nickel, copper, or nickel over copper. The preliminary deposit is usually polished and buffed, and a flash of chromium is deposited upon it. For good-quality work 0.0001 in. of chromium over 0.001 in. of nickel is commonly used. Chromium plating applied in this way is used widely for domestic fixtures, motor-car parts, etc., where a bright appearance is necessary. Against comparatively mild conditions, composite deposits of this type on steel afford good protection.

Samples of steel with electro-deposited-chromium coatings applied over electro-deposited coatings of cadmium were subjected to the intermittent sea-water spray test at Farnborough. The degree of protection against corrosion by sea water afforded by these compound coatings of chromium over cadmium was appreciably less than that of simple electro-deposited coatings of cadmium or zinc. On one sample cracking and flaking of the deposits was visible, and on another sample large badly-rusted areas were observed after four months' exposure to the intermittent sea-water spray test. Other samples showed no rust after four months' exposure, but numerous patches of rust and flaking of the coating occurred at the conclusion of eight months' exposure. It would thus appear that thin coatings of chromium deposited over coatings of cadmium tend to reduce the protective effect of the latter, owing probably to detrimental galvanic effects being produced at discontinuities in the chromium coating.

Sprayed-Aluminium Coatings

The coatings used in the tests were produced with the British type of wire-fed pistol operated under the conditions recommended by a firm using the process. The process is applied to metallic surfaces prepared by sand- or shot-blasting with sharp sand or grit. It is desirable that the coatings shall be reasonably uniform and shall form a good covering at all parts of the work. The average thickness of aluminium coatings used in these tests was 0.0028 in. and the weight was about 2.7 ozs. per sq. yd. The aluminium wire used was of 99.7 per cent. purity.

Samples of 19-s.w.g. mild-steel sheet to B.S.S. 2S3 and of 31-s.w.g. nickel-chromium steel strip to specification D.T.D.54A were sprayed with aluminium, a number of these specimens being subsequently coated with stoving enamel or pigmented-oil varnish. Triplicate samples in the various conditions of surface treatment were exposed at Singapore midway between high- and low-tide marks over a period of 200 days. The frame was exposed in a position so that all the specimens lay in the same horizontal plane and were simultaneously submerged or uncovered according to the state of the tide.

All the samples became thickly coated with barnacle deposits during exposure, but these deposits did not appear to be associated with any pitting or rusting of the samples. Sprayed-aluminium coatings applied to both steels without any supplementary coating afforded very good protection to the steel, and no rust was observed at the conclusion of the corrosion test.

The application of stoving enamel over sprayed-aluminium coatings gave unsatisfactory results on these steels. On examination of the samples at the conclusion of the exposure tests it appeared that the stoving enamel in places had flaked off the samples of mild steel and had lifted the aluminium coating with it, the steel having rusted at the exposed places. The steel strip similarly coated was very badly rusted and pitted at the conclusion of the test, and none of the protective coatings was left on the samples.

Although the supplementary coatings of pigmented oil varnish applied to the aluminium-sprayed steels behaved satisfactorily as such, no increased protection was afforded. The average total weight of the coatings was high, being 6 to 7 ozs. per sq. yd. Sprayed coatings appear to require about twice as much enamel or varnish as ordinary metallic surfaces for the production of films of normal appearance.

The protective effect of the various coatings on the two types of steel was very similar, but in some cases the steel-strip (D.T.D.54A) samples showed more deterioration, owing to the thickness of these samples being a quarter of that of the samples of mild-steel sheet (2S3).

Sprayed-Zinc Coatings

The average thickness of the zinc coatings used in these tests was 0.0028 in., giving an average weight of coating of 7.31 ozs. per sq. yd. The wire used was of 99.95 per cent. purity. The samples sprayed with zinc were almost covered with spots of hard white corrosion product and showed some rust at the conclusion of the corrosion test, but no rust occurred on the zinc-sprayed samples coated with synthetic-resin var-

nish, although there was much white corrosion product and some bare patches where the coatings had peeled off.

Sherardising and Calorising

Sherardising is a process of the hot-diffusion type, in which the steel to be treated is descaled and packed in a mixture of zinc dust and zinc oxide in a metal container and heated to obtain an iron-zinc alloy coating on the surface of the steel. The temperature required during the operation is in the neighbourhood of 390 deg. C.

The following steel strip samples were treated by a proprietary Sherardising process:—28-s.w.g. cold-rolled medium-carbon steel; 24-s.w.g. high-tensile nickel-chromium steel strip to specification D.T.D.54A; 18-s.w.g. spring steel (0.7 per cent. carbon), oil-quenched from 800 deg. C. and tempered at 380 deg. C. The calculated thickness of the protective coating carried by the samples varied between 0.00044 and 0.00069 in.

Duplicate samples of each steel treated were subjected to the intermittent sea-water spray test for 18 months. At the conclusion of the corrosion test the samples showed very little rust, and no appreciable loss in the tensile properties of the steels occurred after exposure.

The following observations are made on these tests:—(*a*) The softening or tempering effect of the Sherardising treatment is not of importance except in the case of very high-strength steel. (*b*) Sherardising treatment affords a very high degree of protection against corrosion by sea-water.

Calorising is a process of the hot-diffusion type similar to Sherardising. The descaled steel is packed in a metal container in a mixture of powdered aluminium, aluminium oxide and a small amount of ammonium chloride. The container is heated at 670-700 deg. C. and rotated during the processing. The aluminium which is deposited on the surface of the steel during the process forms an aluminium-rich iron-aluminium alloy coating on the steel. The process is recommended for the prevention of the scaling of steel at moderately elevated temperatures.

Samples of 20-s.w.g. mild-steel sheets to B.S.S. 283 and of 20-s.w.g. normalised mild-steel sheets, one set of each steel calorised at 670 deg. C. and another set calorised at 700 deg. C., were subjected to the intermittent sea-water spray test at Farnborough over a period of 6 months.

After 3 months' exposure all the samples showed light rust. At the conclusion of the test there were numerous small patches and spots of rust on both samples. No appreciable difference was observed in the corrosion resistance of the two treated steels.

Samples of the untreated steels exposed to the intermittent sea-water spray test with the above treated samples for comparison were excessively rusted after 2 months' exposure. While, therefore, calorising does not appear to be capable of preventing rusting at normal temperatures, it does seem to reduce the rate of corrosion appreciably.

Aluminium Dipping

An aluminium coating on steel is obtained by dipping the descaled steel into a bath of molten aluminium heated to 680-690 deg. C. It is of advantage to coat the steel first with 0.0005 in. of electro-deposited zinc or cadmium to secure satisfactory adhesion of the aluminium at all parts. After 2 months' exposure there was much white corrosion deposit and a few small lumps of gelatinous deposit. At the end of one year the corrosion was only slight, the pitting being fairly shallow. Patches of shallow pitting had increased after 2 years' exposure, and some slight rust at one edge was observed on one of the samples, but there was no rust on the other sample.

At the conclusion of the 3-years' exposure test the samples showed very little change. Although there were numerous patches of pitting, this was very shallow and no pits were observed to have penetrated the aluminium coating. One sample still remained free from rust, and the other sample had only a small amount of rust at one edge.

As shown by the behaviour of the material during 3 years' exposure to the intermittent sea-water spray test, the degree of protection against corrosion afforded to the steel by the coating was very high.

Nickel-Cladding

This method consists of preheating to a suitable temperature a composite slab comprising a steel plate sandwiched between two plates of malleable nickel and hot-rolling to effect the necessary bond between the two metals. Samples of coated sheets welded and unwelded were subjected to the intermittent sea-water spray test at Farnborough for 6 months.

At the conclusion of the exposure tests all the samples showed much rust at cut edges, and in the case of the welded samples spots and patches of rust were visible at the welds. The corrosion elsewhere did not appear to be serious.

Hot-Galvanising

Hot-galvanising is a hot-dipping process in which the descaled steel is immersed in molten zinc carrying a layer of flux over the surface. Four carbon-steel flexible wire ropes treated by proprietary hot-galvanising processes by different firms were subjected to the intermittent sea-water spray test over a period of 6 months at Farnborough.

All the specimens were coated with rust at the conclusion of the corrosion test; however, most of the rust could be washed off under running water. Some slight pitting was observed on some of the wires of each rope.

Gun Blacking

One process which is extensively used consists of coating the steel with a black, hard coating of oxide. The cleaned pieces of steel are immersed in a special bath, removed and allowed to stand for a time, during which they rust. They are then immersed in boiling water, dried and polished, the sequence of operations being repeated five times in all.

The process is usually applied to give a black finish to carbon, nickel and nickel-chromium steels of the usual types, and is not claimed to afford protection to the steel against marine conditions. It does, however, provide a hard surface coating, which is very resistant to abrasion.

Samples of mild-steel sheet and medium-carbon steel sheet were treated by this process and coated with oil. They were exposed to atmospheric corrosion tests at Farnborough over a period of one month. Both series of samples commenced to show rust after 4 days, and after one month's exposure the samples were coated with rust.

Another set of carbon-steel samples treated by a proprietary gun-blacking process was exposed to the intermittent sea-water spray test at Farnborough. Rusting commenced after the first day of exposure, and at the end of one week the samples were almost coated with rust. At the conclusion of one month's exposure to the intermittent sea-water spray test the samples were severely rusted.

Gears Centrifugally Cast by Ford Motor Company

The accompanying illustration shows a group of the centrifugally-cast gears which have been manufactured by the Ford Motor Company, Detroit. According to Mr. R. H. McCarroll, metallurgical engineer of the Ford Company, when production of the gears was started, the moulds were at first spun at speeds ranging from 400 to as high as 1,800 r.p.m., but the speeds of 600 r.p.m. for the ring gear blank and 800 r.p.m. for the transmission gear blank have proved most satisfactory.

International Building Club

Admirable premises have now been secured for the International Building Club at 141, Park Lane, London, W.

Situated as it is close to the Piccadilly end of Park Lane, this building is one which is readily accessible from all parts. Not only is it well arranged for the purpose, but what is perhaps almost of equal importance where club premises are concerned, the building possesses very definite character and personality. Amongst other attractive features should be mentioned the flower garden which leads out from the restaurant on the ground floor and which will no doubt be much used and appreciated by members in the spring and summer months.

It will be recalled that the purpose of the club is mainly social and that membership is open to all who are associated with the building industry. All the usual amenities of a West End club will be provided, and it is intended to pay particular attention to the cuisine and cellar.

The President is Sir Harold Bellman, M.B.E., J.P., and the Vice-Presidents include Alderman W. H. Birch, J.P., President of the National Federation of Building Trades Employers, Mr. W. R. Blair, M.C., M.A., Director, the British Iron-founders' Association, and Mr. P. G. Donald.

The premises now acquired are at present undergoing thorough redecoration but the doors of the club will be open very shortly. Full particulars as to membership may be obtained from the Secretary, Mr. L. J. F. Lawler, at his temporary office, 35, Basildon Court, Devonshire Street, London, W.1.

THE DIRECTORS OF Armstrong Whitworth Securities Company, Limited, announce that, in accordance with the terms of the special resolution passed at the meeting of the company held on June 16, they have repaid to the holders of the 1,000,000 6 per cent. first non-cumulative preference shares and the 1,000,000 4 per cent. second non-cumulative preference shares, all of £1 each, the whole of the capital paid up on such shares.

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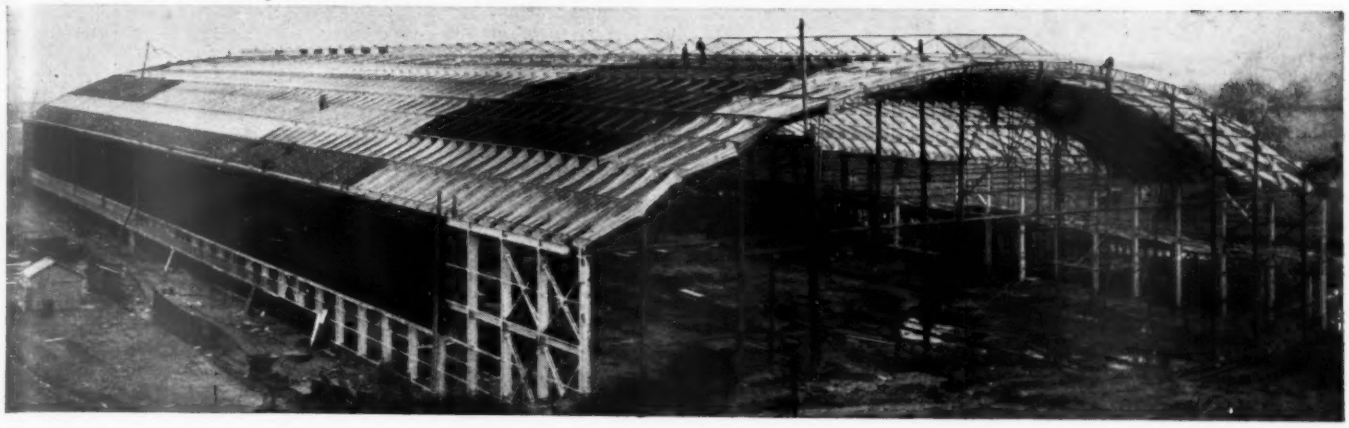

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● **Typical Malleable Pig Iron Specification**

TOTAL CARBON	2·60%
SILICON	·75%
MANGANESE	·50%
SULPHUR	·05%
PHOSPHORUS	·06%

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The Week's News in Brief

Trade Talk

Albion Motors, Limited, Scotstoun, Glasgow, have received an order for 147 six-wheeled chassis.

The English Electric Company, Limited, Stafford, has secured an order from the Borough of Wigan for three 48-seater, double-deck, all-metal bus bodies of the low-bridge type.

Employees of Mackenzie & Moncur, Limited, ironfounders, of Slateford Road, Edinburgh, visited the Empire Exhibition at Glasgow last Saturday as the guests of the company.

Head, Wrightson & Company, Limited, of Thornaby-on-Tees, have opened a branch office at Birmingham, at Central House, 75, New Street. Mr. L. J. Mogridge has been appointed manager.

Production of steel ingots in Canada amounted to 103,729 tons in June, a decline of 4.7 per cent. from May and 7.5 per cent. below the tonnage made in June of last year.

World consumption of nickel in nickel-silver has increased 70 per cent. during the last decade, according to Mr. Robert C. Stanley, chairman and President of the International Nickel Company of Canada, Limited. The nickel-silver industry now ranks second only to the alloy steel industry as a market for nickel.

H.M. Government in the United Kingdom are again taking part officially in the International Trade Fair to be held at Izmir (Smyrna) from August 20 to September 20. The exhibits in the United Kingdom building have been chosen to illustrate the theme of transport, and include models of the L.M.S. express locomotive, "Princess Royal"; flying boats used on the main air routes between this country and the overseas empire; and the Short-Mayo composite aircraft.

A net profit of $6,618,486, equivalent to 42 cents per share on the common stock after allowing for preferred dividend, is reported for the second quarter of 1938 by the International Nickel Company of Canada. This compares with $10,113,764, or 66 cents on the common, for the previous quarter, and $14,199,395, or 94 cents for the second quarter, of 1937. The net profit for the half-year to June 30 thus amounts to $16,732,251, or $1.98 on the common, against $25,914,351, or $1.71 for the corresponding period of last year.

The strike of 85 moulders at the works of W. & J. Lawley, Limited, Britannia Foundry, West Bromwich, which had been in progress since last May, has been settled. As a result of a conference between the Engineering Employers' Association, representatives of the firm, and the executive of the Ironfounding Workers' Association, it was agreed that work would be resumed on August 15 for such of the men for whom work might be available, the firm undertaking to re-engage men as further work became available for them.

The Anti-Attrition Metal Company, Limited, of Glengall Works, Glengall Road, London, S.E.15, has asked us to correct an impression possibly given by the notice which we printed on page 94 of our issue of August 4. This paragraph stated that a general meeting is to be held on August 31 to inform members of the manner in which the winding-up was conducted and the property of the company disposed of. The company referred to in this purely formal notice is one incorporated in 1886, and not the present company, which dates from 1936.

Duncan Stewart & Company, Limited, of Glasgow, have completed an agreement with the Watson-Stillman Company, Roselle, New Jersey, U.S.A., whereby the latter will manufacture for the American market, to the designs of Stewart's, their forging and extrusion presses, air hydraulic accumulators and other hydraulic plant. In turn, Duncan Stewart & Company will manufacture, for the British market, to the designs of Watson-Stillman, their hydraulic horizontal extrusion presses, ingot strippers and other equipment used by the heavy industries.

Fully five weeks remain before the launching on September 27 of the Cunard liner "Queen Elizabeth," but so rapid has been the progress of construction that the vessel could almost be ready for putting into the water within the next fortnight. The most difficult part of the final stages preceding the launch, the fitting of shaft brackets, propeller shafting, rudder frame and stock, is already completed, the arrangements being so far ahead that the launching cradle, fore poppets, etc., are being built into position. The shaft brackets for the outer propellers weigh 180 tons, those for the inner propellers 120 tons, while the rudder stock totals 120 tons. The stern frame and the stem casting weigh respectively 190 tons and 60 tons.

In the exercise of his powers and duties under Part I of the Road Haulage Wages Act, 1938, the Minister of Labour is proceeding to establish the Road Haulage Central Wages Board for Great Britain, and Area Boards for Scotland and for each of the ten Traffic Areas in England and Wales. The Boards are to be established for the purpose of regulating the remuneration of road haulage workers employed in connection with goods vehicles for which A or B licences are required under the Road and Rail Traffic Acts. The Central Board is empowered, after consultation with the Area Boards, to submit to the Minister of Labour proposals concerning the remuneration of the workers concerned; and the Minister is empowered to make an Order making the proposed wages and working conditions obligatory on all employers holding A or B licences.

New Companies

(From the Register compiled by Jordan & Sons, Limited, Company Registration Agents, 116 to 118, Chancery Lane, London, W.C.2.)

Allen, Ashby, Limited, 11, Drayton Road, Tonbridge.—Capital, £2,000. Ironmasters and founders, etc. Directors: A. J. Ashby and R. Allen.

Ancaster Foundry, Limited, 88, High Street, Beckenham, Kent.—Capital, £500. Metallurgists, metal founders, etc. Directors: J. B. Pillin, F. W. Miller, G. B. Aitken and A. F. MacDonald.

Personal

Mr. Tom C. Burnham, a fuel research technologist of Newton, Chambers & Company, Limited, and a grandson of the late Mr. Newton, one of the founders of the firm, was married at Slough on August 4.

Mr. Nelson Harwood, who has left Burnley to become Principal of the Chesterfield Municipal Technical College, has been presented with a radiogram by past and present teachers and students of the Burnley Municipal College engineering department, of which he has been head for 19 years.

Mr. Dan Avey, who has been secretary-treasurer of the American Foundrymen's Association for the past year, has resigned. Mr. R. E. Kennedy, technical secretary, has been elected secretary, while Mr. E. O. Jones has been made treasurer and director of safety and hygiene.

Mr. James Hutton and Mr. W. Chalmers have been appointed to the board of directors of J. Browett Lindley (1931), Limited, of Letchworth. Mr. Hutton has been chief engineer with the company since 1927, and for the past few years has acted in the same capacity for the associated firm, Kryn & Lahy (1928), Limited. Mr. Chalmers has been at Letchworth since 1933, where he became general works manager of the two associated concerns.

The directors of the Richardsons, Westgarth combine, in consequence of the recent amalgamation and reorganisation, have appointed Mr. A. J. Berry, resident manager of the North-Eastern Marine Engineering Company (1938), Limited, at their South Dock Works, Sunderland, director and general manager of George Clark (1936), Limited, Southwick, Sunderland. Mr. M. Mackenzie will assume the duties of assistant manager and Mr. T. Ratcliffe, at present assistant works manager at South Docks, will be transferred to a similar position with George Clark (1936), Limited, at Southwick. At the North-Eastern Marine Engineering Works, South Docks, Mr. G. M. Smibert, engine works manager, has been appointed resident manager in succession to Mr. A. J. Berry, and Mr. J. Ferguson, chief draughtsman, has been appointed to succeed Mr. Smibert as engine works manager.

Wills

Rhodes, H. J., of Kittochside, director of Stewarts and Lloyds, Limited, and chairman of Scottish Tube Company, Limited £31,590

Parrott, Thomas Henry, of Barnt Green, Worcs, chairman and managing director of Belliss & Morcom, Limited, engineers, of Birmingham £204,126

Hyde, John Robert, of Sheffield, chairman of Robert Hyde & Sons, Limited, ironfounders and engineers, of Stoke-on-Trent and Chesterfield £19,004

Bone, Dr. William Henry, of St. Albans, Professor of Chemical Technology at the Imperial College of Science and Technology, University of London ... £43,400

Stroud, Dr. William, chairman and one of the founders of Barr & Stroud, Limited, scientific instrument makers, of Glasgow £152,299

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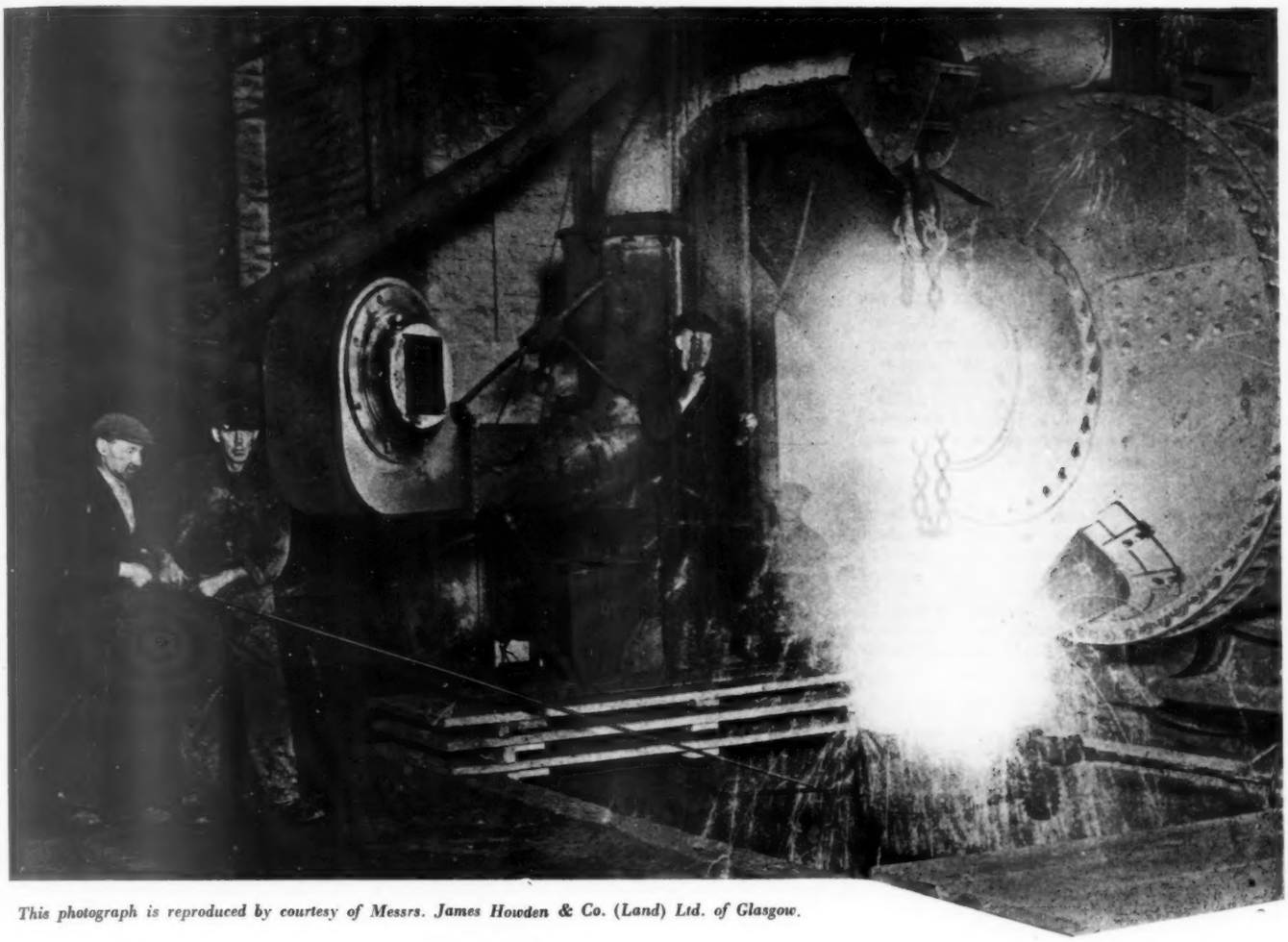

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Raw Material Markets

While it is expected that there will be greater activity at the iron and steel consuming plants in the autumn, and that stocks will by then be appreciably reduced, it is unlikely that there will be any large-scale buying until after the end of the year, as prices are almost certain to be lowered for next year's deliveries.

Pig-Iron

MIDDLESBROUGH.—This is a holiday week on the North-East Coast. This influence apart, it would seem to be quite definite that the main reason for the acute quietness of trade in this area at the present time is the fact that consumers have no desire to take up additional tonnages while prices are at their existing levels. It is generally thought that the majority of users have now got very near to the end of their stocks, but they will not come into the market for large supplies until after the end of the year, when quotations are likely to be lower than at present. Little change is yet apparent in the hematite market and small tonnages only are being taken up. Producers are in possession of very substantial supplies, of which there are no prospects of any early release. For delivery on the North-East Coast, mixed numbers of hematite are quoted on the basis of 132s. 6d., 138s. in Sheffield, 140s. 6d. Manchester, and 143s. 6d. in the Midlands.

LANCASHIRE.—One or two consumers have recently been in the market for small additional tonnages, but new contracts over any period are not being entered into, as lower prices are expected to rule after the turn of the year. On the whole, it seems likely that there will be rather increased activity at the consuming plants during the autumn, when most of the stocks on hand are likely to be consumed. Makers, also, are in possession of heavy stocks, and, despite the reduced production, these must necessarily remain on hand until users re-enter the market on a full scale. Hand-to-mouth business is almost certain to remain until prices are announced for next year's deliveries. In many cases, consumers have still to take up large tonnages under existing contracts, but there has been a welcome improvement in delivery specifications during the past week or two. Offers of Staffordshire and Derbyshire brands of No. 3 foundry pig-iron are being made on the basis of 114s., with Northamptonshire iron at 112s. 6d. per ton, less 5s. rebate. The hematite market continues to be very dull. For delivery in the Manchester area, West Coast material is quoted at 141s. and East Coast at 140s. 6d.

MIDLANDS.—Small tonnages to supplement contracts are changing hands regularly, but there is no large-scale business going through at the present time. The general opinion seems to be that there will be no expansion in trade until next year's quotations have been announced, as consumers, naturally, are not disposed to pay current prices when, by waiting a few months, they will probably be able to negotiate at considerably lower levels. The foregoing remarks, apply, of course, to high-phosphoric pig-iron. The demand for low-phosphorus iron is steadily expanding and the heavy-engineering concerns in the district are taking up quite substantial supplies. No control applies to this grade and prices vary from £5 12s. 6d. to £7 per ton, delivered works here. Consumers of forge iron are well covered and business is very quiet. Most users of hematite are well employed, but, being in possession of adequate tonnages, they are not in need of large supplies, although trade, on the whole, appears to be increasing satisfactorily.

SCOTLAND.—Liquidation of existing stocks of pig-iron at consumers' works is a very slow process, and, consequently, there is still only a small amount of new business in circulation. Orders are for meagre tonnages and contracts are not being entered into for forward business. No. 3 foundry iron is quoted at 118s., with No. 1 at 2s. 6d. per ton more. Activity at the local steelworks is well maintained, but in most cases they are well stocked with supplies of pig-iron. Mixed numbers of hematite are quoted at 133s., Scottish basic 107s. 6d., and English and Indian basic 100s., all less 5s. per ton rebate, delivered steelworks.

Coke

Most consumers of foundry coke are in an independent position and are able to refrain from buying large supplies until prices are reviewed at the end of the year. It is almost certain that reductions will then be made on existing quotations. Meanwhile, best Durham foundry coke for delivery to Birmingham and Black Country stations is quoted at 50s. 6d. per ton, with Welsh coke at from 50s. 6d. to 62s. 6d., according to analysis.

Steel

Production is maintained at a satisfactory level considering the amount of plant which has been closed down for varying periods for the annual holidays, says the official report of the London Iron and Steel Exchange. In many cases deliveries against contracts have been suspended, and the volume of new business has been restricted. The undertone of the market, however, remains firm, and there are indications that active conditions will develop in the early autumn. Business in semi-finished steel is limited and large stocks remain to be worked off. It is reported, however, that some users have disposed of their Continental steel and are now working on British material. Buying in the finished steel section of the market has been confined to small parcels, but the important consuming industries continue to take up large supplies. The heavy-steel works have a good reserve of orders on their books, and recently the demand for the lighter descriptions of steel has shown signs of improving. Export business in all descriptions of steel is irregular.

Scrap

Very quiet trading conditions continue to rule in the iron and steel scrap market in all areas. An indication of this is to be obtained from the fact that in the Cleveland district only one steelworks is now regularly accepting deliveries of scrap. Prices of steel scrap will come up for revision at the end of September, when it is expected that reductions will be made.

Metals

Copper.—Buying interest in this country remains at a low ebb. The holiday season continues to affect consumption, and many consumers are still working short time. On the other hand, consumers in the United States are now showing more interest in the market, and quite good tonnages are changing hands. The copper statistics for the month of July, compiled by the American Copper Institute, reveal that world stocks of refined copper during the month decreased by 28,299 short tons to 523,196 tons. Domestic stocks declined about 19,000 tons to 339,970 tons. The world apparent consumption amounted to 168,000 tons. The world production of refined copper totalled 139,000 tons. On the whole, these figures make quite a good showing, and especially is the decline in the world stocks of refined copper welcomed. Two of the domestic mines of the Kennecott Copper Corporation are shortly to be put into operation again, which is considered in market circles to be unfortunate in existing circumstances.

Metal Exchange quotations were as follow :—

Cash.—Thursday, £41 2s. 6d. to £41 5s.; Friday, £40 8s. 9d. to £40 11s. 3d.; Monday, £40 3s. 9d. to £40 5s.; Tuesday, £39 13s. 9d. to £39 15s.; Wednesday, £39 16s. 3d. to £39 18s. 9d.

Three Months.—Thursday, £41 8s. 9d. to £41 10s.; Friday, £40 15s. to £40 16s. 3d.; Monday, £40 10s. to £40 12s. 6d.; Tuesday, £39 18s. 9d. to £40; Wednesday, £40 1s. 3d. to £40 3s. 9d.

Tin.—The demand for this metal on industrial account in this country, on the Continent, and also in the United States is still very unsatisfactory. Tinplate mills at home and abroad continue to operate at considerably under the normal rate. The weekly market report issued by Brandeis, Goldschimdt & Company, Limited, states that "the price has remained steady and the undertone of the market is quite good. Consumers are not displaying any eagerness to cover their forward requirements, despite the fact that it is known that the objective of the buffer pool is to stabilise the price above the £200 mark. It might have been expected that this price would have been reached the moment the scheme came into operation, but it should not be forgotten that the pool only retains metal and cannot buy it in the open market until it has made sales over the price of £200. At present, therefore, the scheme is only effective in that it is known that tonnages of the metal are being accumulated, which will ultimately come on the market and which may be sold whenever the price reaches £200 per ton or over."

Official quotations were as follow :—

Cash.—Thursday, £194 to £194 5s.; Friday, £193 15s. to £194; Monday, £192 10s. to £193; Tuesday, £191 15s. to £192; Wednesday, £192 15s. to £193.

Three Months.—Thursday, £195 to £195 5s.; Friday, £194 15s. to £195; Monday, £193 15s. to £194; Tuesday, £192 15s. to £193; Wednesday, £193 15s. to £194.

Spelter.—The featureless tone of this market still exists. Consumers are showing very little interest, as is only to be expected under present conditions. The undertone of the market is quite firm and prices have fluctuated within narrow limits. The market in the United States has improved somewhat following the publication of more satisfactory statistics for July. Stocks at the end of that month showed a decline of 3,463 short tons. This is the first decrease for nearly twelve months.

Daily market prices :—

Ordinary.—Thursday, £13 16s. 3d.; Friday, £13 11s. 3d.; Monday, £13 8s. 9d.; Tuesday, £13 2s. 6d.; Wednesday, £13 2s. 6d.

Lead.—Seasonal influences continue to dominate this market and there is little change to report in the position. Some fairly substantial orders have recently emanated from Japan, but now that that country's relations with the Soviet Union are easier there may not be much further large-scale buying from there. A slightly better tone is reported to be ruling in the United States.

Day-to-day quotations :—

Soft Foreign (Prompt).—Thursday, £14 5s.; Friday, £14 2s. 6d.; Monday, £14 5s.; Tuesday, £13 18s. 9d.; Wednesday, £13 18s. 9d.

Scrap.—This market still does not improve very substantially and business is on the quiet side. Merchants have heavy stocks on hand, and it will be some time before these have been liquidated.

Approximate selling prices for old metal :—New aluminium cuttings, £66; rolled, £51; cast, £28; foil, £86 to £88. Copper, £37 to £41; braziery, £33. Brass (clean), £22 to £25. Zinc, £8 10s. Lead, £13. Gunmetal, £40.

American Specifications for Cast Irons

The Committee on Cast Iron (A3) of the American Society for Testing Materials has recommended for publication, as tentative, a revision of the Standard Specifications for grey iron for valves, flanges and pipe fittings (A 126—30). It is now proposed to have three instead of two classes, of which Class A is to give not less than 9.375 tons per sq. in. tensile (unchanged); Class B is now to have not less than 13.8 tons instead of 13.4 tons, and the new Class C is to break at not less than 18.3 tons.

Changes have also been made in the requirements under transverse load under standard American conditions, the breaking load on Class A has been lowered to 2,200 lbs. instead of 2,500 lbs.; Class B remains unchanged, whilst the new Class C must give a minimum of 4,000 lbs. associated with a 0.12 in defection.

MR. JAMES HUTTON, who has been appointed to a seat on the board of J. Browett-Lindley (1931), Limited, has been chief engineer since 1927, and for the past few years has also acted in this capacity for the associated concern of Kryn & Lahy (1928), Limited.